Scientific and Technical Aerospace Reports

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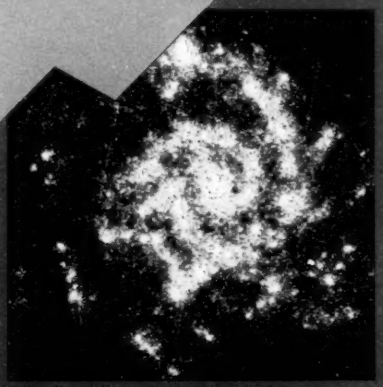

An Abstract Journal

NASA STI PROGRAM SCIENTIFIC & TECHNICAL INFORMATION

Volume 30, Number 10
May 23, 1992
N92-19026 to N92-20045

Scientific and Technical Aerospace Reports

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80 SOCIAL SCIENCES (GENERAL) ..... **N.A.**
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SPACE SCIENCES For related information see also *Geosciences.*

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Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

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Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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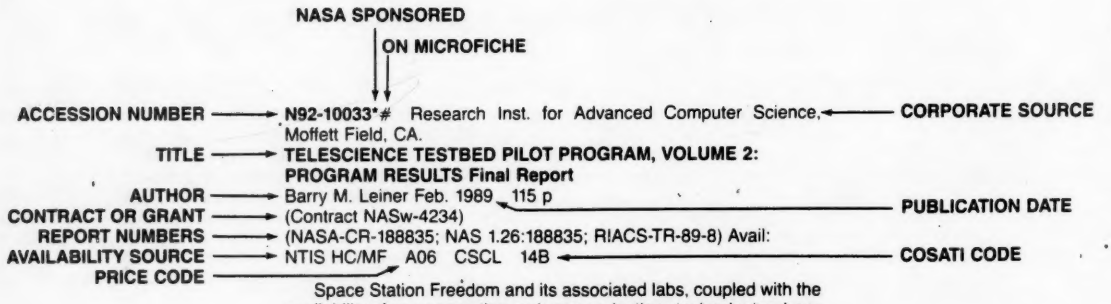
TYPICAL CITATION AND ABSTRACT



Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.

Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-19662# Transportation Research Board, Washington, DC.
PUBLIC-SECTOR AVIATION ISSUES: GRADUATE RESEARCH AWARD PAPERS, 1989 - 1990
1991 63 p Presented at the 70th Transportation Research Board Annual Meeting, Jan. 1991
(PB91-242271; TRB/TRR-1298; LC-91-24111;
ISBN-0-309-05107-X) Avail: NTIS HC/MF A04 CSCL 01B

The following topics are covered: peak-load-congestion pricing of hub airport operations with endogenous scheduling and traffic-flow adjustments at Minneapolis-St. Paul Airport; US Cabotage policy; human orientation and wayfinding in airport passenger terminals; understanding the role of human error in aircraft accidents; analysis of the relationship between financial health and maintenance cost structure of the US airline industry. GRA

N92-19930*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE SHUTTLE ENTRY TERMINAL AREA ENERGY MANAGEMENT
Thomas E. Moore Nov. 1991 50 p
(NASA-TM-104744; S-661; NAS 1.15:104744) Avail: NTIS HC/MF A03 CSCL 01B

A historical account of the development for Shuttle's Terminal Area Energy Management (TAEM) is presented. A derivation and explanation of logic and equations are provided as a supplement to the well documented guidance computation requirements contained within the official Functional Subsystem Software Requirements (FSSR) published by Rockwell for NASA. The FSSR contains the full set of equations and logic, whereas this document addresses just certain areas for amplification. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-19085# Naval Surface Warfare Center, Silver Spring, MD.
NOTES ON THE CAUSE OF PARACHUTE CRITICAL VELOCITY Report, FY 1990 - FY 1991
William P. Ludtke 25 Jun. 1991 62 p
(AD-A244417; NAVSWC-TR-91-178) Avail: NTIS HC/MF A04 CSCL 01/1

This report discusses how the critical velocity of parachutes depends upon the rate of outflow through the canopy surface and the rate of inflow through the canopy mouth. The analysis indicates that the mass flow rate ratio, M', is demonstrated to be the theoretical key to the critical velocity of parachutes. All other observed effects modify the onset of critical velocity. The effects of M' and altitude on inflation reference time, parachute stability, drag coefficient, and inflation rate are also discussed. GRA

N92-19175*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A WEAKLY NONLINEAR THEORY FOR WAVE-VORTEX INTERACTIONS IN CURVED CHANNEL FLOW
Bart A. Singer, Gordon Erlebacher (Institute for Computer Applications in Science and Engineering, Hampton, VA.), and Thomas A. Zang Mar. 1992 26 p
(NASA-TP-3158; L-16989; NAS 1.60:3158) Avail: NTIS HC/MF A03 CSCL 01A

A weakly nonlinear theory is developed to study the interaction of Tollmien-Schlichting (TS) waves and Dean vortices in curved channel flow. The predictions obtained from the theory agree well with results obtained from direct numerical simulations of curved channel flow, especially for low amplitude disturbances. Some discrepancies in the results of a previous theory with direct numerical simulations are resolved. Author

N92-19250*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE INSTABILITY OF BOUNDARY LAYERS ON HEATED FLAT PLATES Final Report
Philip Hall and Helen Morris (Exeter Univ., England) May 1991 72 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187581; ICASE-91-44; NAS 1.26:187581) Avail: NTIS HC/MF A04 CSCL 01A

The stability of a boundary layer on a heated flat plate is investigated in the linear regime. The flow is shown to be unstable to longitudinal vortex structures which in general develop in a nonparallel manner in the streamwise direction. Solutions of the nonparallel equations are obtained numerically at 0(1) values of the appropriate stability parameter, i.e., the Grashof number. The particular cases investigated relate to the situations when the instability is induced by localized or distributed wall roughness or nonuniform wall heating. The case when the vortices are induced by freestream disturbances is also considered. The fastest growing mode is found to be governed by a quasi-parallel theory at high wavenumbers. The wavenumber and growth rate of the fastest growing mode are found in closed form. At low wavenumbers the vortex instability is shown to be closely related to Tollmein-Schlichting waves. The effect of wall heating or cooling on the latter type of instability is discussed. Author

N92-19252# Ecole Normale Superieure, Paris (France). Lab. de Spectroscopie Hertzienne.
REACTION SPEED CONSTANT FOR THE REACTIONS BETWEEN N + O2 AND BETWEEN O + N2 [CONSTANTES DE VITESSE DES REACTIONS N + O2 ET O + N2]
N. Billy, G. Gouedard, J. Vigue, and M. Sizun (Paris-Sud Univ., Orsay, France) 1991 15 p In FRENCH
(Contract DRET-89-174)
(ETN-92-90861) Avail: NTIS HC/MF A03

The reaction speed constants for the reaction between N and O2 producing NO and O between N2 and O producing NO and N are studied in order to develop a model of hypersonic flow within the Earth's atmosphere. The reaction speeds are calculated using a classic trajectory model. The difficulties involved in carrying out these calculations accurately are presented. The rate determining step of the reactions is calculated for several different energy

levels of translation, vibration, and rotation. The reaction rate is then estimated and compared to values found in the literature.
ESA

N92-19296# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
MODELLING OF CHEMICAL AND PHYSICAL EFFECTS WITH RESPECT TO FLOWS AROUND REENTRY BODIES
C. Mundt and E. H. Hirschel 30 Sep. 1991 15 p Presented at the 3rd Aerospace Symposium, Brunswick, Fed. Republic of Germany, 26-28 Aug. 1991
(MBB-FE-211/S/PUB/0465/A; ETN-92-91000) Copyright Avail: NTIS HC/MF A03

A method which solves the Euler and boundary layer equations for hypersonic, chemical nonequilibrium flows is presented. The high temperature air is modeled by a mixture of five species, each considered to behave as a thermally perfect gas. The transport properties are modeled using the Lennard-Jones potential. Applications are presented for the Hermes configuration. A theoretical comparison, with cases including typical wind tunnel influences such as free stream dissociation, for example, shows the versatility of the method. ESA

N92-19304# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A COMPARATIVE STUDY OF NUMERICAL VERSUS ANALYTICAL WAVERIDER SOLUTIONS M.S. Thesis
Gregory O. Stecklein Dec. 1991 130 p
(AD-A244183; AFIT/GAE/ENY/91D-26) Avail: NTIS HC/MF A07 CSCL 01/1

The WL/FIMM explicit, Roe flux-splitting Euler algorithm is applied to the inviscid hypersonic flow over a parabolic-top waverider configuration optimized for Mach 10 at zero degrees angle of attack. An on-design grid refinement study is conducted to determine the asymptotic nature of the optimized flight parameter L/D. A parametric study of off-design conditions is conducted to determine flow perturbation effects on HSDT waverider theory. A validation of the Euler code is conducted through a comparison of the numerical data to analytical results derived by Rasmussen. The grid refinement study shows little effect on the inviscid calculation of the optimized parameter L/D. Good agreement with HSDT waverider theory was attained for the on and off-design evaluations. Approximations involved in the numerical modeling of the waverider design produce large losses of lift as compared to the analytical results. Matching of the analytical results was possible only through a theoretical modeling process. GRA

N92-19354*# Arizona State Univ., Tempe.
AERODYNAMIC ROUGHNESS MEASURED IN THE FIELD AND SIMULATED IN A WIND TUNNEL
Robert Sullivan and Ronald Greeley Feb. 1992 53 p
(Contract NCC2-346)
(NASA-CR-4422; NAS 1.26:4422) Avail: NTIS HC/MF A04 CSCL 01A

This study evaluates how well values of aerodynamic surface roughness, z sub 0, measured over scale models in wind tunnels correlate with values of z sub 0 measured at full scale in the field. A field experiment was conducted in which values of z sub 0 and u* (wind friction speed) were measured over three arrays of non-erodible roughness elements on a dry lake bed. Wind profiles were measured by ten anemometers on a 15 m mast under thermally neutral atmospheric conditions. Values of z sub 0 increased from .00014 m (dry lake bed only) to .026 m with increasing roughness element density. The three roughness element arrays were simulated at 1/10 and 1/20 scale in an open-circuit atmospheric boundary-layer wind tunnel. Velocities were measured with a boundary-layer pitot-tube rake from the same relative position within the scale model arrays as the anemometers were relative to the field arrays. Each array at each scale was sampled three times at five freestream velocities. Average values of z sub 0 for each model array at each scale were compared with full-scale values of z sub 0 obtained in the field. The field vs. wind tunnel correspondence of z sub 0 is found to be z sub 0 field = 0.2661 x (z sub(0 model) x scale(exp -1))exp .8159. Author

N92-19359*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
IDENTIFICATION OF AERODYNAMIC MODELS FOR MANEUVERING AIRCRAFT Semiannual Status Report, 1 Sep. 1991 - 29 Feb. 1992
C. Edward Lan and C. C. Hu 11 Mar. 1992 82 p
(Grant NAG1-1087)
(NASA-CR-190039; NAS 1.26:190039; KU-FRL-872-4) Avail: NTIS HC/MF A05 CSCL 01A

A Fourier analysis method was developed to analyze harmonic forced-oscillation data at high angles of attack as functions of the angle of attack and its time rate of change. The resulting aerodynamic responses at different frequencies are used to build up the aerodynamic models involving time integrals of the indicial type. An efficient numerical method was also developed to evaluate these time integrals for arbitrary motions based on a concept of equivalent harmonic motion. The method was verified by first using results from two-dimensional and three-dimensional linear theories. The developed models for C sub L, C sub D, and C sub M based on high-alpha data for a 70 deg delta wing in harmonic motions showed accurate results in reproducing hysteresis. The aerodynamic models are further verified by comparing with test data using ramp-type motions. Author

N92-19367# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INVESTIGATION OF THE INFLUENCE OF ROTARY AERODYNAMICS ON THE STUDY OF HIGH ANGLE OF ATTACK DYNAMICS OF THE F-15B USING BIFURCATION ANALYSIS M.S. Thesis
Ralph D. Fero Dec. 1991 167 p
(AD-A243969; AFIT/GA/ENY/91D-4) Avail: NTIS HC/MF A08 CSCL 01/1

The purpose of this research was to use bifurcation analysis to investigate the effectiveness of rotary balance data in the prediction of aircraft spin behavior as both a stand alone representation of a model's aerodynamic data and in a conventional hybrid model. Using the foundation of a previously developed model of the F-15B, the rotary balance aerodynamic force and moment data were implemented as a function of angle of attack, angle of sideslip, nondimensional rotation steady state rate and the control surface deflections. Bifurcation diagrams were developed as a function of alpha vs. deflection angles of the rudder, stabilator, and aileron to show highlights of equilibrium and dynamic behavior of the aircraft. For selected configurations, the resulting aircraft state variables showed the rotary balance data model having close correlation to experimental flight test data. Comparison of selected configurations with the hybrid and conventional static and forced oscillation models, showed comparable results. However, the models bifurcation diagrams were very different. Problems were identified with static contributions of the rotary balance data indicating a possible cause. The development of the hybrid model displayed the difficulties in blending of the aerodynamic data in the presence of deficient experimental data or inaccurate data modelling. GRA

N92-19394# Army Natick Labs., MA.
DYNAMICAL SYSTEMS ANALYSIS OF AN AERODYNAMIC DECELERATOR'S BEHAVIOR DURING THE INITIAL OPENING PROCESS Final Report, Oct. 1987 - Sep. 1991
Louis J. Piscitelle Dec. 1991 34 p
(DA Proj. 1L1-61102-AH-52)
(AD-A244194; NATICK/TR-92/017) Avail: NTIS HC/MF A03 CSCL 01/1

A new mathematical model is developed and analyzed to determine the qualitative behavior of an aerodynamic decelerator during the initial opening phase. Currently, all models of canopy opening are valid only once the canopy has begun to inflate and has some assumed shape. The ability to determine the appropriate

initial shape would greatly enhance these models. A set of elastodynamic equations for a simplified canopy model is nonlinearly coupled to Lighthill's model for the relative velocity between a cylinder and the flow past it. Previous work used a linear model for the fluid structure interaction. The new model presented in this paper removes this restriction by using a nonlinear interaction model. The resultant set of nonlinear partial differential equations is expended in terms of a complete set of eigenfunctions. The results is an infinite set of coupled ordinary differential equations in time. This set is then truncated to obtain various sets of low-dimensional models. These models are investigated to determine the stability of the canopy with respect to the fluid's velocity, the line tension, and the drag coefficients. Using dynamical system theory, an understanding of the bifurcation process is obtained without having to solve the full system of nonlinear partial differential equations. Hence, it is possible to predict the onset of divergence and flutter as a function of the system parameters in an efficient manner. GRA

N92-19437*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
UNSTEADY-FLOW-FIELD PREDICTIONS FOR OSCILLATING CASCADES
Dennis L. Huff 1991 24 p Presented at the Sixth International Symposium on Unsteady Aerodynamics, Aeroacoustics, and Aeroelasticity of Turbomachines and Propellers, Notre Dame, IN, 15-19 Sep. 1991; sponsored by the International Union for Theoretical and Applied Mechanics
(NASA-TM-105283; E-6613; NAS 1.15:105283) Avail: NTIS HC/MF A03 CSCL 01A

The unsteady flow field around an oscillating cascade of flat plates with zero stagger was studied by using a time marching Euler code. This case had an exact solution based on linear theory and served as a model problem for studying pressure wave propagation in the numerical solution. The importance of using proper unsteady boundary conditions, grid resolution, and time step size was shown for a moderate reduced frequency. Results show that an approximate nonreflecting boundary condition based on linear theory does a good job of minimizing reflections from the inflow and outflow boundaries and allows the placement of the boundaries to be closer to the airfoils than when reflective boundaries are used. Stretching the boundary to dampen the unsteady waves is another way to minimize reflections. Grid clustering near the plates captures the unsteady flow field better than when uniform grids are used as long as the 'Courant Friedrichs Levy' (CFL) number is less than 1 for a sufficient portion of the grid. Finally, a solution based on an optimization of grid, CFL number, and boundary conditions shows good agreement with linear theory. Author

N92-19545*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
AN INITIAL INVESTIGATION INTO METHODS OF COMPUTING TRANSONIC AERODYNAMIC SENSITIVITY COEFFICIENTS Semiannual Progress Report, Jul. - Dec. 1991
Leland A. Carlson Feb. 1992 78 p
(Grant NAG1-793)
(NASA-CR-190040; NAS 1.26:190040; TAMRF-5802-92-01)
Avail: NTIS HC/MF A05 CSCL 01A

Research conducted during the period from July 1991 through December 1992 is covered. A method based upon the quasi-analytical approach was developed for computing the aerodynamic sensitivity coefficients of three dimensional wings in transonic and subsonic flow. In addition, the method computes for comparison purposes the aerodynamic sensitivity coefficients using the finite difference approach. The accuracy and validity of the methods are currently under investigation. Author

N92-19623 California Inst. of Tech., Pasadena.
ACTIVE CONTROL OF THE FLOW PAST A CYLINDER EXECUTING ROTARY MOTIONS Ph.D. Thesis
Phillip Takeo Tokumaru 1991 117 p
Avail: Univ. Microfilms Order No. DA9137297

Experiments were performed on circular cylinders executing forced rotary motions in a steady uniform flow. These motions include harmonic oscillations, steady rotation, and combinations of the two. Flow visualization and laser Doppler velocimetry measurements were used to characterize the wake structure, and to estimate the convection speed, spacing, and strength of the vortical structures. Laser-Doppler velocimetry measurements were also made to estimate the cylinder drag coefficient and wake displacement thickness. Also, the periodic flow close to the cylinder and in the near wake region was mapped for a particular forced case. The data show that a considerable amount of control can be exerted over the flow by such means. In particular, a large increase, or decrease, in the resulting displacement thickness, estimated cylinder drag, and associated mixing with the free stream can be achieved, depending on the frequency and amplitude of oscillation. In order to assess the effects of oscillatory forcing on a cylinder with a net (mean) rotation rate, a novel method for estimating the steady lift forces was used. Using this method, it was also found that the addition of forced rotary oscillations to the steady rotation of the cylinder helped to increase C sub L in the cases where the wake would normally be separated in the steadily rotating case, and decrease it otherwise. Dissert. Abstr.

N92-19679# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics.
EXPERIMENTAL STUDIES OF VORTEX FLAPS AND VORTEX PLATES. PART 1: 0.53 m SPAN 60 DEG DELTA WING
K. Rinoie (National Aerospace Lab., Tokyo, Japan) and J. L. Stollery Aug. 1991 44 p
(Cranfield-Aero-9113-Pt-1; ISBN-1-871564-33-6; ETN-92-91052)
Avail: NTIS HC/MF A03; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC 8 sterling pounds

Low speed tunnel tests were made to investigate the flow around a leading edge vortex flap at the maximum lift/drag conditions. Tests were also made to measure the performance of the inverted vortex flap and the vortex plate. The force measurements and flow visualization tests were conducted in a 60 degree delta wing model. Results indicate that the lift to drag ratio is a maximum for any given flap deflection angle when the flow comes smoothly onto the deflected vortex flap without forming a large leading edge separation vortex in the flap surface. The benefit of the vortex plate is seen in the drag results which are smaller than those for the datum wing. This benefit is due to some leading edge suction acting on the forward facing region between the delta wing and the vortex plate. ESA

N92-19682# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
DRAG PREDICTION USING COMPUTATION METHODS Final Summary Report [PREVISION DE LA TRAINEE A PARTIR DES METHODES DE CALCUL. RAPPORT DE SYNTHESE FINAL]
J. J. Thibert, J. L. Godard, and F. Montigny-Rannou Feb. 1989 61 p In FRENCH
(Contract DRET-88-34-001)
(ONERA-RSF-82/1685-AY-154-4; ETN-92-91080) Avail: NTIS HC/MF A04

Different two and three dimensional computation methods for the prediction of drag were studied. The integration of pressure was concluded to not allow a correct estimation of the C(sub x) pressure term which is too sensitive to numerous parameters (equations, mesh, convergence, numerical viscosity, etc.). This term can perhaps be evaluated using motion evaluation which gives access to the C(sub x) shock and C(sub x) induced terms. The accuracy thus obtained depends on the evaluation process used and on the numerical method (type of equations, numerical scheme, artificial viscosity, etc.). The best evaluations of viscous effect drag are obtained using wake calculations. The evaluations made show that it is possible to attain accuracy of some 'percent' in the absence of spread detachment. This accuracy level is adapted by adapting the the C(sub x) estimation method to the computation

method used. Detail and precise tests in two and three dimensions are necessary to further improve the prediction methods. ESA

N92-19698 Virginia Polytechnic Inst. and State Univ., Blacksburg.
INTEGRATED AERODYNAMIC-STRUCTURAL-CONTROL WING DESIGN Ph.D. Thesis
Masoud Rais-Rohani 1991 136 p
Avail: Univ. Microfilms Order No. DA9201147

The aerodynamic-structural-control design of a simplified wing and forward-swept composite wing are studied. In the first example, the wing is modeled as a beam with a control surface near the wing tip. The torsional stiffness is the only physical property varying along the span. The aerodynamic model is based on strip theory, and the control model is based on output feedback control. With the structural-control interaction being the main focus, two different approaches are taken for the simplified wing design: (1) a sequential approach; and (2) an integrated approach. In each approach, the wing is designed for minimum weight subject to divergence and control deflection constraints. The results indicated that while the integrated approach produced a better design than the sequential approach, the difference was minimal. In the second example, a forward-swept composite wing is designed for a high subsonic transport aircraft. The structural analysis is based on the finite-element method. The aerodynamic calculations are based on the vortex-lattice method, and the control calculations are based on output feedback control. The wing is designed for minimum weight subject to structural, aerodynamic/performance and control constraints. Efficient methods are used to calculate the control deflection and efficiency sensitivities which appear as second order derivatives in the control constraint equations. To suppress the aeroelastic divergence of the forward-swept wing, and to reduce the gross weight of the design aircraft, two separate cases are studied: (1) combined application of aeroelastic tailoring and active controls; and (2) aeroelastic tailoring alone. The results indicated that, for this particular example, aeroelastic tailoring is sufficient for suppressing the aeroelastic divergence, and the use of active controls was not necessary. Dissert. Abstr.

N92-19925# Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France). Lab. d'Etudes Aerodynamiques.
HYPERSONIC WAKES Final Report [SILLAGES HYPERSONIQUES. RAPPORT FINAL]
M. C. Guegan, C. Tenaud, and T. Alziary Jul. 1991 72 p In FRENCH
(Contract DRET-89-34-080-00-470-75-01)
(ETN-92-91082) Avail: NTIS HC/MF A04

Experimental studies on transition over a cone in hypersonic regime, and transition in wakes and near wakes, are presented. The experimental wind tunnel setup is described. The code developed for the bottom flow in laminar hypersonic regime is presented. The introduction of turbulence modeling is described. ESA

N92-19993*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CALCULATIONS OF HOT GAS INGESTION FOR A STOVL AIRCRAFT MODEL
David M. Fricker, James D. Holdeman, and Surya P. Vanka (Illinois Univ., Urbana.) 1992 10 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA Original contains color illustrations
(NASA-TM-105437; E-6808; NAS 1.15:105437; AIAA-92-0385; AVSCOM-TR-91-C-053) Avail: NTIS HC/MF A02; 5 functional color pages CSCL 01A

Hot gas ingestion problems for Short Take-Off, Vertical Landing (STOVL) aircraft are typically approached with empirical methods and experience. In this study, the hot gas environment around a STOVL aircraft was modeled as multiple jets in crossflow with inlet suction. The flow field was calculated with a Navier-Stokes, Reynolds-averaged, turbulent, 3D computational fluid dynamics code using a multigrid technique. A simple model of a STOVL aircraft with four choked jets at 1000 K was studied at various heights, headwind speeds, and thrust splay angles in a modest parametric study. Scientific visualization of the computed flow field shows a pair of vortices in front of the inlet. This and other qualitative aspects of the flow field agree well with experimental data. Author

N92-20038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFLUENCE OF AIRFOIL GEOMETRY ON DELTA WING LEADING-EDGE VORTICES AND VORTEX-INDUCED AERODYNAMICS AT SUPERSONIC SPEEDS
Richard M. Wood, James E. Byrd, and Gary F. Wesselmann (Arnold Engineering Development Center, Arnold Air Force Station, TN.) Washington Feb. 1992 86 p
(NASA-TP-3105; L-16851; NAS 1.60:3105) Avail: NTIS HC/MF A05 CSCL 01A

An assessment of the influence of airfoil geometry on delta wing leading edge vortex flow and vortex induced aerodynamics at supersonic speeds is discussed. A series of delta wing wind tunnel models were tested over a Mach number range from 1.7 to 2.0. The model geometric variables included leading edge sweep and airfoil shape. Surface pressure data, vapor screen, and oil flow photograph data were taken to evaluate the complex structure of the vortices and shocks on the family of wings tested. The data show that airfoil shape has a significant impact on the wing upper surface flow structure and pressure distribution, but has a minimal impact on the integrated upper surface pressure increments. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-19259# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
GROUND COLLISION AVOIDANCE USING A VARIABLE INCIDENCE ALTITUDE MEASUREMENT SYSTEM FOR THE A-7 AIRCRAFT M.S. Thesis
Thomas A. Hartung Dec. 1991 114 p
(AD-A243880; AFIT/GAE/ENY/91D-15) Avail: NTIS HC/MF A06 CSCL 01/2

This study examines the use of a forward looking sensor in the implementation of an automatic terrain following system. The effect of the incidence angle is studied as well as methodologies to include dynamic motion in the pointing of the sensor beam. The methods examined include fixed angle with respect to the aircraft, dynamics driven by a simple gain, and dynamics directed to gather the terrain information a fixed time interval ahead of the aircraft. Incidence angles of 25, 50, 75, and 90 are examined. The terrain obstacles include a single parabolic hill, a step change in terrain, and a double parabolic hill. Compensator design was accomplished using MATLAB (Trademark) software using Linear Quadratic Gaussian Techniques. State space system realization of the closed loop dynamics were used by a FORTRAN program to run the simulations. Performance was judged by qualitative assessment of flight path, quantitative score of summed distances away from commanded 300 ft AGL altitude, and amount of control power required. The best performance was achieved by the 50 degree incidence angle. Dynamic motion of the sensor beam improved performance but required more control deflection. The best dynamic pointing method was the constant time interval technique. GRA

N92-19276*# FWG Associates, Inc., Tullahoma, TN.
PARTICLE TRAJECTORY COMPUTER PROGRAM FOR ICING ANALYSIS OF AXISYMMETRIC BODIES Final Report
Walter Frost, Ho-Pen Chang, and Kenneth R. Kimble 21 Apr. 1982 121 p

(Contract NAS3-22448)
(NASA-CR-189134; NAS 1.26:189134) Avail: NTIS HC/MF A06 CSCL 01C

General aviation aircraft and helicopters exposed to an icing environment can accumulate ice resulting in a sharp increase in drag and reduction of maximum lift causing hazardous flight conditions. NASA Lewis Research Center (LeRC) is conducting a program to examine, with the aid of high-speed computer facilities, how the trajectories of particles contribute to the ice accumulation on airfoils and engine inlets. This study, as part of the NASA/LeRC research program, develops a computer program for the calculation of icing particle trajectories and impingement limits relative to axisymmetric bodies in the leeward-windward symmetry plane. The methodology employed in the current particle trajectory calculation is to integrate the governing equations of particle motion in a flow field computed by the Douglas axisymmetric potential flow program. The three-degrees-of-freedom (horizontal, vertical, and pitch) motion of the particle is considered. The particle is assumed to be acted upon by aerodynamic lift and drag forces, gravitational forces, and for nonspherical particles, aerodynamic moments. The particle momentum equation is integrated to determine the particle trajectory. Derivation of the governing equations and the method of their solution are described in Section 2.0. General features, as well as input/output instructions for the particle trajectory computer program, are described in Section 3.0. The details of the computer program are described in Section 4.0. Examples of the calculation of particle trajectories demonstrating application of the trajectory program to given axisymmetric inlet test cases are presented in Section 5.0. For the examples presented, the particles are treated as spherical water droplets. In Section 6.0, limitations of the program relative to excessive computer time and recommendations in this regard are discussed. Author

N92-19350# Institut de Mecanique des Fluides de Lille (France).
AIRPLANE CRASHES ON THE RUNWAY. FINE MODELING OF THE BEHAVIOR AFTER BURNING OF A FRAME SUBMITTED TO LINEAR CRUSHING [CRASH DES AVIONS SUR PISTE. MODELISATION FINE DU COMPORTEMENT POST FLAMBEMENT D'UN CADRE SOUMIS A UN ECRASEMENT LINEIQUE]
E. Deletombe and P. Geoffroy 21 Dec. 1990 68 p In FRENCH
(Contract DRET-86-003-04)
(IMFL-90-64; ETN-92-90868) Avail: NTIS HC/MF A04

A numerical model of the crushing behavior of the frame of a scale model airplane is developed. The model is based on the elastoplastic properties of materials and is shown to be globally and locally accurate on its representation of the real behavior of a crushed frame. This is particularly true of the plastification physics found in the area of plastic bending in accordion-type crushing of the frame. The model is designed to identify the laws governing the macro- or super-elements in order to economically model plastification areas within an actual airplane fuselage. ESA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-19041# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
THE COMPAS SYSTEM IN THE ATC ENVIRONMENT
Fred V. Schick and Uwe Voelckers Dec. 1990 164 p Annual DLR Inst. for Flight Guidance Scientific Seminar held in Brunswick, Fed. Republic of Germany, 12-13 Sep. 1990 Original contains color illustrations
(DLR-Mitt-91-08; ISSN-0939-298X; ETN-92-90729) Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

Papers from the 1990 seminar, which focused on a particular Air Traffic Control (ATC) issue, automated planning aids for approach control, are presented. The intention of the seminar was to give a comprehensive view of the development of Computer Oriented Metering Planning Advisory System (COMPAS) and its operational application at the Frankfurt control center (Fed. Republic of Germany) Fundamental principles, operational implementation, field test results, and future plans were covered. For individual titles, see N92-19042 through N92-19050.

N92-19042# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
DESIGN PRINCIPLES OF AUTOMATION AIDS FOR ATC APPROACH CONTROL
Uwe Voelckers *In its* The COMPAS System in the ATC Environment Dec. 1990 11 p (For primary document see N92-19041 10-04)
Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

During the past decade several automation aids to assist controllers in approach control were developed in Western Europe and the U.S. While the principal functions and elements are very similar in all systems, the different developments show a variety of individual solutions, mostly with regard to the degree of automation, the role of the human controller, the degree of detail of models and algorithms, and the design of the man-machine interface. The design principles and criteria of the Air Traffic Control (ATC) Computer Oriented Metering Planning Advisory System (COMPAS) are presented and compared with other solutions. ESA

N92-19043# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
COMPAS SYSTEM CONCEPT
M. Schubert *In its* The COMPAS System in the ATC Environment Dec. 1990 19 p Original contains color illustrations (For primary document see N92-19041 10-04)
Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

The management of arrival traffic has become one of the most difficult problems in air traffic control. The main objective of the Computer Oriented Metering Planning Advisory System (COMPAS) project was to find solutions and to gain experience in the application of a computer assisted system in the extended approach area. COMPAS was designed to help controllers in their planning and coordination functions and to efficiently merge the arrival traffic into Frankfurt airport (Fed. Republic of Germany). There is a series of models in the system which describe the air traffic control process, the economical flight profiles, the airspace structure plus the analytical method, and models for arrival sequencing. The COMPAS objectives, requirements, and models are described and the controller computer interface of the experimental system is considered in more detail. ESA

N92-19044# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
EVALUATION OF THE COMPAS EXPERIMENTAL SYSTEM
Fred V. Schick *In its* The COMPAS System in the ATC Environment Dec. 1990 17 p (For primary document see N92-19041 10-04)
Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

For the evaluation of the functional capacity and the operational performance of Computer Aided Metering Planning Advisory System (COMPAS), traffic related aspects and human factors aspects were assessed in a series of experiments at Air Traffic

Control (ATC) simulation facilities, with controllers as subjects. The evaluation was done in two major steps. The first step dealt with system layout. It resulted in an optimized design of algorithms, man/machine interface, and control principles of the system, which was in the second step submitted to a large scale evaluation, with more than 100 hours of simulation time. Three sources of data were used: traffic data, operational data of controller work, and controller judgements. The results indicated that COMPAS served as a helpful tool for reducing the effort for approach sequencing and for coordination. The guidance of approach traffic in the terminal area was facilitated by the planning system. ESA

N92-19045# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).

EXPERIENCES DEVELOPED IN TRANSFERING THE EXPERIMENTAL COMPAS SYSTEM TO AN OPERATIONAL PROTOTYPE VERSION

H.-D. Schenk *In its* The COMPAS System in the ATC Environment Dec. 1990 19 p Original contains color illustrations (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

To achieve the development and assessment of new systems, procedures and concepts to meet the requirements of the ongoing technical evolution, requires covering the areas from the first idea, to conceptional studies, up to simulations, investigations and assessments in simulated environments. In the development and assessment of the ATC (Air Traffic Control) planning system COMPAS (Computer Oriented Metering Planning Advisory System) the step from transferring the results and outcomes from the experimental investigations into the development of an operational prototype version and its assessment under real operational conditions was undertaken. The special points of interest, problems and experiences found in this process based on the different requirements between the experimental and the operational system and their supporting environments are covered. ESA

N92-19046# ATConsult, Frankfurt (Germany, F.R.).

STEPS TOWARD ACCEPTANCE

K.-H. Mink *In* DLR, The COMPAS System in the ATC Environment Dec. 1990 15 p (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

As air traffic controllers will continue to play the main role in Air Traffic Control (ATC), the achievement of acceptance is a prime concern when implementing new ATC system elements. Careful steps of increasing controller participation during all phases of system development and a continuous dialogue with the users is vital for successful implementation. The various steps taken during the COMPAS (Computer Oriented Metering Planning Advisory System) development as well as the lessons learned are described. ESA

N92-19047# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).

EVALUATION OF THE COMPAS OPERATIONAL SYSTEM

Fred V. Schick *In its* The COMPAS System in the ATC Environment Dec. 1990 18 p (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

For an evaluation of the operational version of COMPAS (Computer Oriented Metering Planning Advisory Service) in terms of traffic flow, system operation and controller acceptance, a six month field test was carried out. The results indicated that the planning system enabled controllers to establish overall planned approach sequences; thereby contributing to straight and easy traffic flow as well as to the fairness of the final sequences. As regards the impact of COMPAS on controller work, there were distinct results obtained for APPROACH control and for the Area Control Center (ACC). ESA

N92-19048# AEG-Electrocom G.m.b.H., Konstanz (Germany, F.R.).

EXTENSION OF THE FRANKFURT COMPAS FOR GENERAL APPLICATION

W. Parthier *In* DLR, The COMPAS System in the ATC Environment Dec. 1990 8 p (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

A prerequisite for the maintainability and worldwide marketing of COMPAS (Computer Oriented Metering Planning Advisory System) is a standardized software basis and independence of hardware (e.g., Ada/UNIX). The system basis is outlined and the planned steps to modify the existing COMPAS-OP (adaptation of COMPAS for field tests in Frankfurt, Fed. Republic of Germany) to generate a more or less generally applicable COMPAS are described. ESA

N92-19049# Bundesanstalt fuer Flugsicherung, Frankfurt am Main (Germany, F.R.).

THE IMPACT OF COMPAS ON THE FUTURE COOPERATIVE AIR TRAFFIC MANAGEMENT CONCEPT (CATMAC)

K. Platz *In* DLR, The COMPAS System in the ATC Environment Dec. 1990 17 p (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

A new concept for the future provision of air traffic services in Germany was developed. The concept is called the Cooperative Air Traffic Management Concept (CATMAC). CATMAC is characterized by improved accuracy and higher reliability of planning data, and by adequate sharing of tasks between automated ground and airborne systems. The experience gained in the development and the operational evaluation of COMPAS (Computer Oriented Metering Planning Advisory System) were of great importance to the definition of the CATMAC concept. ESA

N92-19050# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. for Flight Guidance.

THE ROLE OF PLANNING SYSTEMS IN FUTURE AIR TRAFFIC MANAGEMENT

H. Winter *In its* The COMPAS System in the ATC Environment Dec. 1990 20 p (For primary document see N92-19041 10-04)

Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

In order to increase the productivity of air traffic control, the controllers have to be supported by computers. An analysis of the mental functions performed by the controllers was made and it is proposed to support the subfunction 'planning' by computers. The coupling between the time and space dimensions of planning makes distributed planning necessary. Global strategic and local tactical planning provide a largely conflict free planned traffic which will be monitored and controlled by the controllers. ESA

N92-19391# Federal Aviation Administration, Cambridge, MA. National Transportation Systems Center.

CDI SENSITIVITY AND CROSSTRACK ERROR ON NONPRECISION APPROACHES Final Report, Jun. 1988 - Jun. 1990

M. S. Huntley, Jr., Christopher J. Rourke, and Robert M. DiSario Sep. 1991 40 p

(AD-A243981; DOTVNTSC-FAA-91-2; DOT/FAA/RD-91-18)

Avail: NTIS HC/MF A03 CSCL 01/4

This report is concerned with the influence of display needle sensitivity on the accuracy with which pilots can fly nonprecision approaches. Twelve private pilots flew an instrumented single

engine airplane on 144 approaches at six different sensitivity levels. The study was conducted to determine the influence of course deviation indicator (CDI) sensitivity on pilot tracking error. The sensitivities ranged from 15,190 feet (2.5 nautical miles) to 475 feet (0.08 nautical miles) for a full-scale deflection. Increase in sensitivity of this magnitude decreased crosstrack Root Mean Square error from an average of 0.22 to 0.04 nautical miles. Magnitude of the error influence of sensitivity on that increases in sensitivity on that magnitude were affected by distance from the missed approach point. Pilots reported that increases in sensitivity increased their-workload and changed their distribution of attention among the aircraft instruments used for navigation and directional control. GRA

N92-19491# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

ESTIMATING THE PROBABILITY OF VERTICAL OVERLAP FROM THE PAIRED AIRCRAFT DATA OBTAINED IN THE EUROPEAN VERTICAL DATA COLLECTION USING THE PROGRAM DGLDIF

G. Moek 8 Jul. 1988 182 p
(Contract RLD-LVB/L-24575)
(NLR-TR-88108-U; ETN-92-90954) Avail: NTIS HC/MF A09

The problem of estimating the probability of vertical overlap in possible future airway systems with a vertical separation standard of 100 ft. above Flight Level 290 is addressed. It forms part of an overall safety assessment of such potential systems. The problem is solved by developing a mathematical probability model of the vertical distance between aircraft in a pair. A priori unknown model parameters are estimated by means of the maximum likelihood method from presently available data in the height keeping performance of aircraft in Europe based on the Double Generalized Laplace (DGL) probability distributions. Special attention is given to the effect on the modeling process of the limited amount of data on large height keeping errors. The point estimate obtained is 0.0000023 to 0.0000066 while an associated 95 pct. interval estimate is 0.0000148. ESA

N92-19604# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

GPS/INS INTEGRATION FOR IMPROVED AIRCRAFT ATTITUDE ESTIMATES M.S. Thesis

Daniel T. Bagley Dec. 1991 242 p
(AD-A243947; AFIT/GE/ENG/91D-04) Avail: NTIS HC/MF A11 CSCL 01/4

This report documents research into the design, implementation, and analysis of a post-mission navigation error estimation algorithm for the Electronic Counter-Countermeasures/Advanced Radar Test Bed (ARTB). In order to quantify the effects of Electronic Countermeasures (ECM) on a given radar accurately, extremely accurate navigation information for ARTB and a given test target must be available for use as reference or truth data. Presently, the ARTB navigation subsystem provides adequate accuracy in position and velocity; however, its computation of attitude does not meet the level of accuracy required for airborne radar flight testing. An extended Kalman filter algorithm is implemented in a filter-driving-filter configuration to integrate the outputs of a Global Positioning System Receiver 3A and a SNU 84-1 Inertial Navigation System in order to estimate and compensate for inertial navigation system errors. The specific objective of integrating the two systems is to enhance the accuracy of ARTB's attitude indications. Outputs from the 12-state GPS Kalman filter simulation are used as measurements in the 23-state Integration Kalman Filter. Monte Carlo simulations are run for measurement update intervals of 5, 10, and 15 seconds, and for both benign (less than 2 G) and highly dynamic (up to 9 G) flight scenarios. Cross-correlation between GPS Kalman filter estimation errors and true INS system errors is also examined. GRA

N92-20029*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE CENTER/TRACON AUTOMATION SYSTEM (CTAS): A VIDEO PRESENTATION

Steven M. Green and Jeannine Freeman (SYRE Corp., Moffett Field, CA.) Jan. 1992 7 p
(NASA-TM-103887; A-91223; NAS 1.15:103887) Avail: NTIS HC/MF A02 CSCL 17G

NASA Ames, working with the FAA, has developed a highly effective set of automation tools for aiding the air traffic controller in traffic management within the terminal area. To effectively demonstrate these tools, the video AAV-1372, entitled 'Center/TRACON Automation System,' was produced. The script to the video is provided along with instructions for its acquisition. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-19030# Defence Research Establishment Suffield, Ralston (Alberta).

DRES UNMANNED AERIAL VEHICLE DATA LINK RESEARCH Memorandum Report

Thomas E. Ollevier Nov. 1991 31 p
(AD-A244272; DRES-Memo-1355) Avail: NTIS HC/MF A03 CSCL 01/3

The command and control system of a typical UAV system consists of the airborne command and control system (ACCS), the ground control station (GCS), and the data links required to enable communication between the ACCS and the GCS. This report describes the data links presently used by DRES and the proposed improvements to these systems. It provides background on work carried out in the past with the emphasis on how this work nas affected the design of UAV data links at DRES. Requirements of both operational and research UAV data links are also described. The report proposes a possible framework for future research in the area of data links for UAVs including a proposal for research into the feasibility of steerable antennas for UAVs. The work would start with the integration of existing antenna system elements with the UAV autopilot being used as the antenna controller. At the same time work would begin on the design of a steerable antenna with a gain of approx. 10 db. This work would provide a basis for the design of higher gain UAV data link antennas and special purpose antennas such as those required by communications repeaters and sonobuoy repeaters. GRA

N92-19178# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

ANALYSIS OF THE EFFECTS OF REMOVING NOSE BALLAST FROM THE F-15 EAGLE M.S. Thesis

Richard L. Bennett Dec. 1991 82 p
(AD-A244044; AFIT/GA/ENY/91D-1) Avail: NTIS HC/MF A05 CSCL 01/3

This study investigated the results of removing lead ballast from the nose section of the F-15 Air Superiority fighter. The goal of the investigation was to determine if aircraft handling qualities remained acceptable with the ballast removed, and also to determine what improvements in aircraft nose pointing authority resulted. Actual F-15 weight reports were used to calculate the worst case aft center of gravity location shift due to the ballast removal. Several configurations with different center of gravity locations (based on various amounts of lead weights removed) were used for comparison to the baseline aircraft. Moments of inertia were calculated for each configuration, which in turn were used in a 6 degree of freedom computer simulation of the F-15. Simulation test points were then examined throughout the flight

envelope of the F-15. Simulation results and better aircraft weight management results support removing (on average) approximately 200 pounds of lead ballast from the nose section of the single seat Air Superiority F-15 Eagle, with a resulting 3 percent increase in pitch rate. A suggested flight test profile is presented for flight verification of the simulation results. GRA

N92-19185# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS OF AN ADVANCED FIGHTER AIRCRAFT USING JET FLAP TECHNIQUES AND THE VORTEX LATTICE METHOD M.S. Thesis
Steven P. Snyder Dec. 1991 138 p
(AD-A244051; AFIT/GAE/ENY/91D-27) Avail: NTIS HC/MF A07 CSCL 01/1

A computer code using the vortex lattice method with modified boundary conditions was used to determine the induced aerodynamic characteristics of high aspect ratio, vectoring, exhaust nozzles located at the wing root of a canard configured fighter aircraft. Comparison with existing wind tunnel data verified results of the method. The exhaust was modeled as a singularly blown jet flap at deflection angles of -10, 0, 10, 20, 30, and 40 degrees. Jet momentum coefficients were based on gross engine thrust for maximum afterburner and military power settings at a Mach number of 0.6 and an altitude of 20,000 ft. Lift, induced drag, and pitching moment coefficients were calculated for untrimmed conditions. The nozzle provided lift augmentation at all deflections and blowing conditions, a reduction in induced drag at high lift coefficients, and an increased nose down-pitching moment. An optimum flap deflection to achieve minimum induced drag existed for each unique lift and blowing condition. Measurement of the static margin showed that the aircraft as configured was statically unstable. Example cases of comparable wing platforms varying in aspect ratio from 2 to 5 and taper ratio from 0.05 to 1 showed similar behavior. GRA

N92-19192# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PERFORMANCE AND STABILITY ANALYSIS OF THE NON-LINEAR DYNAMICS OF A SIMPLE POWERED LIFTING HYPERSONIC VEHICLE FLYING ON A MINOR CIRCLE M.S. Thesis
Mark A. Zavala Dec. 1991 162 p
(AD-A243933; AFIT/GA/ENY/91D-11) Avail: NTIS HC/MF A08 CSCL 22/3

The nonlinear equations of motion for a hypersonic vehicle flying on a minor circle were modeled using the control design and simulation software package, MATRIXx. The model includes earth rotation and gravity gradient effects. Aerodynamic forces and moments are expressed as first order Taylor series expansions using the full nonlinear expression for the dynamic pressure. Minor circle equilibrium flight conditions are generated via a Newton iteration technique (Turbo Pascal program) for both a rotating and non-rotating earth model. Equilibrium performance over speeds from Mach 5 to Mach 40 and 0 to 85 degree latitudes at east and west flight headings are compared. The speed and latitude determine equilibrium bank angles, altitude, and roll, pitch, and yaw control moments (to sustain minor circle flight). These parameters are analyzed to assess equilibrium performance. Results show that earth rotation and gravity gradient torques have significant effects on performance. The system is shown (via MATRIXx) to be marginally unstable. For near-major circle routes, the modes are poorly damped and decoupled into lateral and longitudinal modes. For mid-latitude minor circle routes, the modes are poorly damped and coupled. However, the modes are comprised of either mostly longitudinal or mostly lateral states. For minor circle latitudes greater than 65 deg, we see poorly damped coupled modes, with new mode shapes appearing as equilibrium speeds increase. GRA

N92-19225# Aix-Marseilles Univ. (France). Inst. de Mecanique Statistique de la Turbulence.
HOT JET DILUTOR Final Summary Report [DILUEUR DE JET CHAUD. RAPPORT DE SYNTHESE FINALE]
M. Amielh and M. P. Chauve Feb. 1991 105 p In FRENCH
(Contract DRET-89-169)
(ETN-92-90860) Avail: NTIS HC/MF A06

The hot gases produced by the exhaust of helicopters produce a very visible infrared signature. A hot jet dilutor is proposed as a means of reducing this infrared signature. Various two dimensional hot jet dilutor geometries are studied. Data generated by these models is used to validate calculation codes to be used in simulating flows in various ejector configurations in order to optimize their operation. The experimental methods and techniques used are described in detail. ESA

N92-19374*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
KAPPA GROUP: THE INITIAL GUESS. A PROPOSAL IN RESPONSE TO A COMMERCIAL AIR TRANSPORTATION STUDY Final Design Proposal
May 1991 88 p Sponsored in part by Boeing Commercial Airplane Co.
(Contract NASw-4435)
(NASA-CR-189981; NAS 1.26:189981) Avail: NTIS HC/MF A05 CSCL 01C

Kappa Aerospace presents their Aeroworld Aircraft, the Initial Guess (IG). This aircraft is designed to generate profit in the market which is currently controlled by the train and boat industry. The main priority of the design team was to develop an extremely efficient aircraft that could be sold at a reasonable price. The IG offers a quick and safe alternative to the existing means of transportation at a competitive price. The cruise velocity of 28 ft/sec. allows all flights to be between 20 and 45 minutes, which is a remarkable savings in time compared to travel by boat or train. The IG is propelled by a single Astro-05 engine with a Zinger 10-6 propeller. The Astro-05 is not an extremely powerful engine; however, it provides enough thrust to meet the design and safety requirements. The major advantage of the Astro-05 is that it is the most efficient engine available. The fuel efficiency of the Astro-05 is what puts the aircraft ahead of the competition. The money saved on an efficient engine can be passed on as lower ticket prices or increased revenue. The IG has a payload of 56 passengers and a wingspan of 7 ft. The 7 ft. wingspan allows the aircraft to fit into the gates of all of the cities that are targeted. Future endeavors of Kappa Aerospace will include fitting a stretch version of the IG with a larger propulsion system. This derivative aircraft will be able to carry more passengers and will be placed on the routes which have the greatest demand for travel. The fuselage and empennage are made of a wooden truss configuration, while the wing is made of a rib/spare configuration. The stress carrying elements are made of spruce, the nonstress carrying elements are made of balsa. The wing is removable for easy access into the fuselage. The easy access to the batteries will keep maintenance costs down. Author

N92-19496*# California Polytechnic State Univ., San Luis Obispo.
PROPOSAL FOR A LOW COST CLOSE AIR SUPPORT AIRCRAFT FOR THE YEAR 2000: THE RAPTOR
Jerome D. Brown, Ward S. DeWitt, Mark McDonald, John W. Riley, Anthony E. Roberts, Sean Watson, and Margaret M. Whelan 10 May 1991 83 p
(Contract NASw-4435)
(NASA-CR-190023; NAS 1.26:190023) Avail: NTIS HC/MF A05 CSCL 01C

The Raptor is a proposed low cost Close Air Support (CAS) aircraft for the U.S. Military. The Raptor incorporates a 'cranked arrow' wing planform, and uses canards instead of a traditional horizontal tail. The Raptor is designed to be capable of responsive delivery of effective ordnance in close proximity to friendly ground forces during the day, night, and 'under the weather' conditions. Details are presented of the Raptor's mission, configuration,

performance, stability and control, ground support, manufacturing, and overall cost to permit engineering evaluation of the proposed design. A description of the design process and analysis methods used is also provided. Author

N92-19563*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TILTROTOR RESEARCH AIRCRAFT COMPOSITE BLADE REPAIRS: LESSONS LEARNED
Paul S. Espinosa and David R. Groepler Dec. 1991 20 p Presented at the Eighth International Conference on Composite Materials, Honolulu, HI, Jul. 1991
(NASA-TM-103875; A-91189; NAS 1.15:103875) Avail: NTIS HC/MF A03 CSCL 01C

The XV-15, N703NA Tiltrotor Research Aircraft located at the NASA Ames Research Center, Moffett Field, California, currently uses a set of composite rotor blades of complex shape known as the advanced technology blades (ATBs). The main structural element of the blades is a D-spar constructed of unidirectional, angled fiberglass/graphite, with the aft fairing portion of the blades constructed of a fiberglass cross-ply skin bonded to a Nomex honeycomb core. The blade tip is a removable laminate shell that fits over the outboard section of the spar structure, which contains a cavity to retain balance weights. Two types of tip shells are used for research. One is highly twisted (more than a conventional helicopter blade) and has a hollow core constructed of a thin Nomex-honeycomb-and-fiberglass-skin sandwich; the other is untwisted with a solid Nomex honeycomb core and a fiberglass cross-ply skin. During initial flight testing of the blades, a number of problems in the composite structure were encountered. These problems included debonding between the fiberglass skin and the honeycomb core, failure of the honeycomb core, failures in fiberglass splices, cracks in fiberglass blocks, misalignment of mated composite parts, and failures of retention of metal fasteners. Substantial time was spent in identifying and repairing these problems. Discussed here are the types of problems encountered, the inspection procedures used to identify each problem, the repairs performed on the damaged or flawed areas, the level of criticality of the problems, and the monitoring of repaired areas. It is hoped that this discussion will help designers, analysts, and experimenters in the future as the use of composites becomes more prevalent. Author

N92-19701 Cranfield Inst. of Tech., Bedford (England).
A STUDY OF THE AEROELASTIC BEHAVIOUR OF HELICOPTER ROTOR BLADES FEATURING SWEPT TIPS Ph.D. Thesis
R. H. Markiewicz 1990 302 p
Avail: Univ. Microfilms Order No. BRDX93762

The design of a model helicopter rotor blade incorporating a swept tip is described. The swept tip is chosen to provide a coupling between the lift at the tip and the blade twist, thus achieving a variation of blade twist with azimuth and with forward speed. The design is the first step in an investigation of aeroelastic tailoring as a means of reducing helicopter vibration and increasing rotor performance. The first prototype blade encountered stability problems and further designs were evaluated using a new modes/stability computer program developed within RAE. Comparisons are made between the stresses measured on a second stable swept tip blade and a dynamically similar rectangular blade. The results show that a beneficial twisting of the swept tip blade is achieved which enhances rotor performance and reduces the flatwise bending and torsional moments. Comparisons are made between the experimental results and those predicted by the RAE/WHL for the flatwise moments, but a more representative model of the hub is needed to produce acceptable predictions of the torsional moments. The design of a further set of blades is discussed, the aim being to investigate the effects of introducing a strong coupling between the flap and torsion motions of the blade by sweeping back the shear center. An analysis of the results shows that there are large gains in blade stability with no severe adverse effects on blade loads. A theoretical investigation was undertaken to observe the effects of tip sweep on the performance of a full size rotor. The results show that aft tip sweep can reduce control loads and rotor power for a rotor with a cambered aerofoil section. Dissert. Abstr.

N92-19846*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OPTIMIZING TUNING MASSES FOR HELICOPTER ROTOR BLADE VIBRATION REDUCTION INCLUDING COMPUTED AIRLOADS AND COMPARISON WITH TEST DATA
Jocelyn I. Pritchard, Howard M. Adelman, Joanne L. Walsh, and Matthew L. Wilbur Jan. 1992 11 p Presented at the 33rd Structures, Structural Dynamics, and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(DA Proj. 1L6-2211-A-47-AA)
(NASA-TM-104194; AVSCOM-TR-91-B-020; NAS 1.15:104194)
Avail: NTIS HC/MF A03 CSCL 01C

The development and validation of an optimization procedure to systematically place tuning masses along a rotor blade span to minimize vibratory loads are described. The masses and their corresponding locations are the design variables that are manipulated to reduce the harmonics of hub shear for a four-bladed rotor system without adding a large mass penalty. The procedure incorporates a comprehensive helicopter analysis to calculate the airloads. Predicting changes in airloads due to changes in design variables is an important feature of this research. The procedure was applied to a one-sixth, Mach-scaled rotor blade model to place three masses and then again to place six masses. In both cases the added mass was able to achieve significant reductions in the hub shear. In addition, the procedure was applied to place a single mass of fixed value on a blade model to reduce the hub shear for three flight conditions. The analytical results were compared to experimental data from a wind tunnel test performed in the Langley Transonic Dynamics Tunnel. The correlation of the mass location was good and the trend of the mass location with respect to flight speed was predicted fairly well. However, it was noted that the analysis was not entirely successful at predicting the absolute magnitudes of the fixed system loads. Author

N92-19847*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A MATHEMATICAL MODEL OF A TILT-WING AIRCRAFT FOR PILOTED SIMULATION
Joseph J. Totah Jan. 1992 15 p
(NASA-TM-103864; A-91150; NAS 1.15:103864) Avail: NTIS HC/MF A03 CSCL 01C

A mathematical model of a tilt-wing aircraft that was used in a piloted, six-degree-of-freedom flight simulation application is described. Two types of control systems developed for the math model are discussed: a conventional, programmed-flap wing-tilt control system and a geared-flap wing-tilt control system. The primary objective was to develop the capability to study tilt-wing aircraft. Experienced Tilt-wing pilots subjectively evaluated the model using programmed-flap control to assess the quality of the simulation. The math model was then applied to study geared-flap control to investigate the possibility of eliminating the need for auxilary pitch-control devices (such as the horizontal tail rotor or tail jet used in earlier tilt-wing designs). This investigation was performed in the moving-base simulation environment, and the vehicle responses with programmed-flap and geared-flap control were compared. The results of the evaluation of the math model are discussed. Author

N92-19871*# Douglas Aircraft Co., Inc., Long Beach, CA.
AN EXPLORATION OF FUNCTION ANALYSIS AND FUNCTION ALLOCATION IN THE COMMERCIAL FLIGHT DOMAIN Final Report
James C. McGuire, John A. Zich, Richard T. Goins, Jeffery B. Erickson, John P. Dwyer, William J. Cody, and William B. Rouse (Search Technology, Inc., Norcross, GA.) Washington NASA Nov. 1991 364 p
(Contract NAS1-18028)
(NASA-CR-4374; NAS 1.26:4374) Avail: NTIS HC/MF A16 CSCL 01C

The applicability is explored of functional analysis methods to support cockpit design. Specifically, alternative techniques are studied for ensuring an effective division of responsibility between the flight crew and automation. A functional decomposition is performed of the commercial flight domain to provide the information necessary to support allocation decisions and demonstrate methodology for allocating functions to flight crew or to automation. The function analysis employed 'bottom up' and 'top down' analyses and demonstrated the comparability of identified functions, using the 'lift off' segment of the 'take off' phase as a test case. The normal flight mission and selected contingencies were addressed. Two alternative methods for using the functional description in the allocation of functions between man and machine were investigated. The two methods were compared in order to ascertain their relative strengths and weaknesses. Finally, conclusions were drawn regarding the practical utility of function analysis methods. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-19097# Minnesota Univ., Minneapolis. Heat Transfer Lab.
STUDIES OF GAS TURBINE HEAT TRANSFER: AIRFOIL SURFACES AND END-WALL COOLING EFFECTS Final Report, Apr. 1989 - Apr. 1991
E. R. Eckert, R. J. Goldstein, S. V. Patankar, and T. W. Simon Sep. 1991 46 p
(Contract F49620-89-C-0060)
(AD-A244055; AFOSR-91-0954TR) Avail: NTIS HC/MF A03 CSCL 13/1

The report documents accomplishments made toward understanding the fluid flow and heat transfer processes in gas turbines at the University of Minnesota over the past two years. The research is divided into three subtopics: studies of film cooling, airfoil surface heat transfer and endwall flow and heat transfer. Film cooling experiments show the effects of interaction among jets on curved surfaces and calculations show that parabolic techniques give accurate effectiveness predictions in regions away from injection holes. The surface heat transfer program showed that tripping the flow or roughening the wall has a clear effect near airfoil transition and separation points and that recovery from concave curvature is surprisingly slow. Endwall studies show flow visualization on the cascade endwall and the value of a fence on the endwall for rerouting the horseshoe vortex away from the suction wall. GRA

N92-19184# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EFFECT OF NONUNIFORM ENTRANCE FLOW PROFILE ON HYPERSONIC NOZZLE PITCHING MOMENT M.S. Thesis
Sandra L. Snelling Dec. 1991 106 p
(AD-A244050; AFIT/GA/ENY/91D-13) Avail: NTIS HC/MF A06 CSCL 21/5

The Scramjet Hypersonic Nozzle (SCHNOZ) parabolized Navier-Stokes computer code was used to model turbulent, chemically reacting flow present in a hypersonic nozzle. Two nozzle configurations were considered, an isolated nozzle (no external flow) and a nozzle with a finite length cowl. A single nonuniform entrance flow profile was generated and an equivalent uniform flow profile calculated for input into the nozzle code. Uniform and nonuniform cases for each nozzle were run using both frozen and finite rate chemistry. An increased grid resolution in the computer code was necessary to eliminate numerically induced anomalies in the results of the nonuniform cases for both nozzle configurations. Comparisons between the finite rate and frozen flow cases showed that chemistry was essentially frozen for the finite rate cases, indicating that for the nozzle inlet conditions and geometry used in this study, the extra computational time spent on finite rate kinetics was unnecessary. The effects of the nonuniform flowfield used in this study included an increase in the overall vehicles thrust and a decrease in the overall vehicle moment. GRA

N92-19235# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EXPERIMENTAL INVESTIGATION INTO THE EFFECTS OF RIBLETS ON COMPRESSOR CASCADE PERFORMANCE M.S. Thesis
James A. Rothenflue Dec. 1991 137 p
(AD-A243881; AFIT/GAE/ENY/91D-5) Avail: NTIS HC/MF A07 CSCL 21/5

The effects of adding riblets to the blades of a subsonic, linear compressor cascade were investigated at the Air Force Institute of Technology. Three blade configurations were tested, including a set of unmodified NACA 64-A905 series blades, a set with riblets applied to the suction surface, and a set with riblets on the pressure surface. Performance was evaluated over a wide range of Reynolds numbers, and at low and high free stream turbulence levels. Cascade performance was evaluated in terms of total pressure loss coefficient, turning angle, and static pressure rise. No riblet configuration offered robust cascade performance improvements; however, performance was significantly enhanced under certain specific conditions. Riblets also degraded cascade performance at other conditions. GRA

N92-19328# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THE EFFECT OF ANGLE OF INCIDENCE AND REYNOLDS NUMBER ON HEAT TRANSFER IN A LINEAR TURBINE CASCADE M.S. Thesis
Steven Meschwitz Dec. 1991 188 p
(AD-A243900; AFIT/GAE/ENY/91D-6) Avail: NTIS HC/MF A09 CSCL 21/5

The AFIT linear Turbine Cascade Test Facility was used to study the effect of the small changes in the angle of incidence on turbine blade convective heat transfer. Other parameters studied were the model Reynolds number and the freestream turbulence level. Characterization tests, performed to determine the feasibility of the study were followed by a series of tests designed to separate the effects of the angle of incidence, Reynolds number, and freestream turbulence level on convective heat transfer. For any given freestream turbulence level or angle of incidence, there is an increase in the heat transfer coefficient for an increase in the Reynolds number. For the low freestream turbulence (0.5 pct.) configuration at a given Reynolds number, there is a decrease in the convective heat transfer coefficient with an increase in the angle of incidence, partially a result of the decrease in the cascade passage velocity and partially a result of the variation in boundary layer behavior. For the high freestream turbulence configuration (10 pct.) at any Reynolds number, there is an obvious increase in the convective heat transfer coefficient over that for the low turbulence configuration; however, the transitional or fully turbulent boundary layer makes it difficult to observe any relation between

the convective heat transfer coefficient and the angle of incidence. GRA

N92-19329# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
EXPERIMENTAL INVESTIGATION OF TRAILING EDGE CRENULATION EFFECTS ON LOSSES IN A COMPRESSOR CASCADE M.S. Thesis
Steven J. Decook Dec. 1991 117 p
(AD-A243902; AFIT/GAE/ENY/91D-1) Avail: NTIS HC/MF A06 CSCL 21/5

The effects of blade trailing edge crenulations on wake losses in a compressor cascade were investigated at the Air Force Institute of Technology. The cascade used NACA 64-A905 blades with a turning angle of about 30 to model last row stators of an axial flow compressor. Three blade configurations were used: unmodified blades, blades with large crenulations, and blades with small crenulations. Wake losses and mixing were evaluated in four flow conditions, generated by combinations of increased freestream turbulence and sidewall boundary layer removal. Injection of air perpendicular to the inlet flow increased freestream turbulence from about 0.15 to about 4 pct. The sidewall boundary layers could be removed by suction through sidewall slots immediately ahead of the cascade. A total pressure wake measured the difference between upstream and downstream total pressure, yielding pressure loss and velocity data, and hot wire anemometry was used downstream from the cascade to measure flow angle, relative turbulence, and velocity. For each test condition, the crenulated blades decreased total pressure loss, the wake velocity deficit, and wake velocity variance by about 10 to 20 pct., while slightly decreasing turning angle and increasing the turbulence level. The size of the crenulations had a small effect on these parameters. GRA

N92-19726*# General Electric Co., Cincinnati, OH. Aircraft Engine Business Group.
COMPONENT-SPECIFIC MODELING Final Report
R. L. McKnight, R. J. Maffeo, M. T. Tipton, and G. Weber Jan. 1992 109 p
(Contract NAS3-23687)
(NASA-CR-189088; NAS 1.26:189088) Avail: NTIS HC/MF A06 CSCL 21E

Accomplishments are described for a 3 year program to develop methodology for component-specific modeling of aircraft hot section components (turbine blades, turbine vanes, and burner liners). These accomplishments include: (1) engine thermodynamic and mission models, (2) geometry model generators, (3) remeshing, (4) specialty three-dimensional inelastic structural analysis, (5) computationally efficient solvers, (6) adaptive solution strategies, (7) engine performance parameters/component response variables decomposition and synthesis, (8) integrated software architecture and development, and (9) validation cases for software developed. Author

N92-19938# Rolls-Royce Ltd., Derby (England).
MATERIALS AND PROCESS DIRECTIONS FOR ADVANCED AERO-ENGINE DESIGN
D. Driver 15 Nov. 1990 21 p Presented at the High Temp. Materials for Powder Engineering, Liege, Belgium, 1990 Previously announced in IAA as A91-52506 Submitted for publication
(PNR-90814; ETN-92-90782) Copyright Avail: NTIS HC/MF A03

A view of future air transport projections is given and how the resulting new aeroengine design will influence materials and processing technology is assessed. Modern military aircraft require gas turbines of mechanically simple design with few highly loaded components operating at high turbine entry temperatures in order to achieve high thrust to weight ratios. For civil aircraft the need for low cost of ownership leads to fuel efficient ultrahigh bypass ratio turbofan engines with relatively low purchase and maintenance costs and with extended component life reliability. The associated demands in materials technology are for high specific strength and stiffness, increased temperature capability and for manufacturing processes which enable components with tailored microstructures and properties to be made in a consistent and cost effective manner. The trend towards 'designer materials' is already being demonstrated with single crystal technology and with thermomechanically and powder processed components, but future demands will require a move from monolithic materials to more complex metal matrix, intermetallic, glass and ceramic composite structures, often involving manufacturing routes where the material and the component are made in the same processing operation. ESA

N92-19939# Rolls-Royce Ltd., Derby (England). Civil Powerplant Technology Div.
RE-ENGINING APPEARS TO OFFER BEST PAYBACK FOR YOUNG: CHAPTER 2 COMPLIANT AIRCRAFT
M. J. T. Smith 15 Nov. 1990 4 p Repr. from ICAO Journal, Nov. 1990 p 12-14 Previously announced in IAA as A91-29053
(PNR-90848; ETN-92-90798) Copyright Avail: NTIS HC/MF A01

As a result of aircraft noise regulations, Chapter 2 compliant aircraft are faced with the prospect of enforced retirement by around the year 2000, and a tougher action at airports even earlier. The options for the older aircraft owner are in increasing order of cost: to do nothing, operating where the aircraft is acceptable for as long as possible, and then scrapping it (this is the obvious course of action with very old airframe); where technically possible to risk getting by with a bolt on hushkit, and then operating until further local noise constraints force scrapping; to rengine with a modern turbofan and, as a result, have an environmentally acceptable and valuable airframe as an asset (this option is attractive to owners of young airframes); to sell the aircraft while it still has resale value, and by a much more expensive replacement. The pros and cons of the 'hushkit' and 're-engine' options are considered. The re-engining option appears the most advantageous, having a whole array of benefits besides outstanding noise reduction, the hushkitting offering little real noise alleviation, especially at take off. ESA

N92-20033*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA'S ROTARY ENGINE TECHNOLOGY ENABLEMENT PROGRAM: 1983-1991
Edward A. Willis (Sverdrup Technology, Inc., Brook Park, OH.) and John J. McFadden 1992 13 p Presented at the International Congress and Exposition, Detroit, MI, 24-28 Feb. 1992; sponsored by SAE
(NASA-TM-105562; E-6868; NAS 1.15:105562) Avail: NTIS HC/MF A03 CSCL 21E

A brief review is provided of NASA's Rotary Engine Technology Enablement Program from 1983 through 1991, with primary emphasis on the CFD approaches used since 1987. The main discussion includes both code development and applications to several particularly difficult internal air flow, fuel air mixing, and combustion related problems. A summary of the final status of the technology is given. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-19174*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
LINEARIZED AERODYNAMIC AND CONTROL LAW MODELS OF THE X-29A AIRPLANE AND COMPARISON WITH FLIGHT DATA
John T. Bosworth Feb. 1992 113 p
(NASA-TM-4356; H-1676; NAS 1.15:4356) Avail: NTIS HC/MF A06 CSCL 01C

Flight control system design and analysis for aircraft rely on mathematical models of the vehicle dynamics. In addition to a six degree of freedom nonlinear simulation, the X-29A flight controls group developed a set of programs that calculate linear perturbation models throughout the X-29A flight envelope. The models include the aerodynamics as well as flight control system dynamics and were used for stability, controllability, and handling qualities analysis. These linear models were compared to flight test results to help provide a safe flight envelope expansion. A description is given of the linear models at three flight conditions and two flight control system modes. The models are presented with a level of detail that would allow the reader to reproduce the linear results if desired. Comparison between the response of the linear model and flight measured responses are presented to demonstrate the strengths and weaknesses of the linear models' ability to predict flight dynamics. Author

N92-19241# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
APPLICATION OF NONLINEAR QFT TO FLIGHT CONTROL DESIGN FOR HIGH ANGLE OF ATTACK MANEUVERS WITH THRUST VECTORING M.S. Thesis
Steven J. Rasmussen Dec. 1991 179 p
(AD-A243821; AFIT/GE/EN/91D-44) Avail: NTIS HC/MF A09 CSCL 01/4

Nonlinear Quantitative Feedback Theory (QFT) is applied to the design of a Flight Control System (FCS) to control maneuvers of an agile aircraft. To do this, maneuvers are chosen that are desirable during visual range combat. Plant transfer functions are developed through the use of system identification, using the input/output time histories of the maneuvers. During the system identification process the q (sub ij)(o) are found directly and are constrained to be minimum phase. After identifying the plants, the cascaded multiple-input multiple-output QFT technique is used to design the FCS. During the design of the FCS, stability boundaries are generated through the use of a Matrix sub x program. To prevent the formation of large RHP poles, Gamma-boundaries are developed. Before shaping the loops it is found that FCS scheduling is needed because of large uncertainty in the magnitude and phase of the plants. Because the orders of the designed controllers are too large for the YF-16 simulation program, reduced order controllers are developed through the use of straight line approximations on the Bode plot. After implementing the reduced order controllers in the nonlinear simulation program, problems developed in the modeling process are encountered that prevent the simulation of the FCS's. GRA

N92-19295# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Automatique.
DOUBLE LOOP CONTROL LAW STRATEGY AND APPLICATIONS TO HELICOPTER Interim Report [STRATEGIE DE LOI DE COMMANDE A 2 BOUCLES ET APPLICATIONS A L'HELICOPTERE. RAPPORT INTERMEDIAIRE]
Christiane Samblancat, Jean-Francois Magni, Pierre Apkarian, and Philippe Mouyon Mar. 1991 81 p In FRENCH
(Contract DRET-89-002-36-1-3-4)
(CERT-2/7724-DERA; ETN-92-90871) Avail: NTIS HC/MF A05

A double loop command rule strategy using placement structure and H infinity synthesis is described. Transitory placement is treated by means of placement modes while the robustness and the permanent regime are considered via H infinity synthesis. The advantages of the method are illustrated through helicopter piloting, which is a practical problem involving movement uncoupling specifications as well as robustness in terms of the rotor dynamics which are not taken into consideration. ESA

N92-19499*# Boeing Commercial Airplane Co., Seattle, WA.
NASA TSRV ESSENTIAL FLIGHT CONTROL SYSTEM REQUIREMENTS VIA OBJECT ORIENTED ANALYSIS Final Report
Keith S. Duffy and Bradley J. Hoza Mar. 1992 199 p
(Contract NAS1-18027)
(NASA-CR-189573; NAS 1.26:189573) Avail: NTIS HC/MF A09 CSCL 01C

The objective was to analyze the baseline flight control system of the Transport Systems Research Vehicle (TSRV) and to develop a system specification that offers high visibility of the essential system requirements in order to facilitate the future development of alternate, more advanced software architectures. The flight control system is defined to be the baseline software for the TSRV research flight deck, including all navigation, guidance, and control functions, and primary pilot displays. The Object Oriented Analysis (OOA) methodology developed is used to develop a system requirement definition. The scope of the requirements definition contained herein is limited to a portion of the Flight Management/Flight Control computer functionality. The development of a partial system requirements definition is documented, and includes a discussion of the tasks required to increase the scope of the requirements definition and recommendations for follow-on research. Author

N92-19505# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PROPORTIONAL PLUS INTEGRAL CONTROL OF AIRCRAFT FOR AUTOMATED MANEUVERING FORMATION FLIGHT M.S. Thesis
John L. Dargan Dec. 1991 184 p
(AD-A243792; AFIT/GE/EN/91D-14) Avail: NTIS HC/MF A09 CSCL 01/4

In this study an automated formation control system for a lead and wing aircraft flight is developed. The proposed formation control system is capable of controlling like or dissimilar aircraft in maneuvering formation flight. Thus, two versions of the C-130 aircraft, the C-130A and the C-130B, are modelled. The C-130B has superior performance characteristics to that of the C-130A. The wing aircraft continuously measures lead aircraft position with an ideal on-board relative position sensor, maneuvering to maintain relative position. External formation guidance is assumed to be released in a single data burst, consisting of formation geometry and nominal separation commands for each aircraft in the formation. No continuous communication is assumed between formation aircraft. Simulation of the formation control system reveals that a controller is needed to alleviate the steady state errors in separation distance after a formation maneuver is executed. Hence, a Proportional plus Integral formation system control has been developed, which allows aircraft with differing performance capabilities to safely and effectively execute all maneuvers evaluated in the study. Moreover, the formation control system is shown to satisfactorily operate independently of the aircraft or formation configuration being flown. There is zero steady state error for all maneuver and separation distance responses, and the transients are such that no collision occurs between the aircraft in the formation. GRA

N92-19621 Oxford Univ. (England).
ROBUST CONTROL SYSTEM DESIGN WITH APPLICATION TO HIGH PERFORMANCE HELICOPTERS Ph.D. Thesis
Michael Stanley Tombs 1987 225 p
Avail: Univ. Microfilms Order No. BRD-93833

One of the first applications of H-infinity optimization to the design of controllers for industrial problems is presented. The system considered was an unstable helicopter model, obtained from a larger nonlinear simulation configured to represent future high performance helicopters. The problem was to design a full authority flight control system, to stabilize the aircraft and decouple the controlled inputs, thus reducing pilot workload. Robustness was a primary issue because of model uncertainty, particularly due to the omission from the design model of higher order rotor dynamics. The optimization problem was based on the minimization of sensitivity (for performance) and control output (for robustness) transfer functions. Simple weighting functions were found to be useful for examining the fundamental performance versus robustness tradeoff, and to be more effective at shaping the closed loop transfer functions than LQG/LTR techniques. An important

improvement to the H-infinity optimization solution process was the development of a numerically reliable algorithm to perform minimal realization. Dissert. Abstr.

N92-19841*# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
NONLINEAR STABILITY AND CONTROL STUDY OF HIGHLY MANEUVERABLE HIGH PERFORMANCE AIRCRAFT, PHASE 2 Semiannual Report
R. R. Mohler 14 Feb. 1992 64 p
(Grant NAG1-1081)
(NASA-CR-189911; NAS 1.26:189911; OSU-ECE-92-01) Avail: NTIS HC/MF A04 CSCL 01C

Research leading to the development of new nonlinear methodologies for the adaptive control and stability analysis of high angle of attack aircraft such as the F-18 is discussed. The emphasis has been on nonlinear adaptive control, but associated model development, system identification, stability analysis, and simulation were studied in some detail as well. Studies indicated that nonlinear adaptive control can outperform linear adaptive control for rapid maneuvers with large changes in angle of attack. Included here are studies on nonlinear model algorithmic controller design and an analysis of nonlinear system stability using robust stability analysis for linear systems. Author

N92-20026# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel Working Group 9.
VALIDATION OF FLIGHT CRITICAL CONTROL SYSTEMS
Gordon Belcher, ed., Duncan E. McIver, ed., and Kenneth J. Szalai, ed. Dec. 1991 136 p
(AGARD-AR-274; ISBN-92-835-0650-2) Copyright Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The objectives of the research is the following: (1) to provide guidance to those concerned in the Flight Critical Control System (FCCS) validation, namely systems designers and certification authorities; and (2) to identify the areas of research which need to be explored to enable validation of the next generation of FCCS. An attempt was made to review all flight critical control system validation activities which had been completed or were under active consideration, in Europe and the U.S. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-19218*# MCAT Inst., San Jose, CA.
STUDY OF OPTICAL TECHNIQUES FOR THE AMES UNITARY WIND TUNNELS. PART 1: SCHLIEREN Progress Report
George Lee Feb. 1992 32 p
(Contract NCC2-716)
(NASA-CR-189951; NAS 1.26:189951; Rept-92-002) Avail: NTIS HC/MF A03 CSCL 14B

Alignment procedures and conceptual designs for the rapid alignment of the Ames Unitary Wind Tunnel schlieren systems were devised. The schlieren systems can be aligned by translating the light source, the mirrors, and the knife edge equal distances. One design for rapid alignment consists of a manual pin locking scheme. The other is a motorized electronic position scheme. A study of two optical concepts which can be used with the schlieren system was made. These are the 'point diffraction interferometers' and the 'focus schlieren'. Effects of vibrations were studied. Author

N92-19642# Simtec, Inc., Manassas, VA.
SIMULATOR DATA INTEGRITY PROGRAM: PROCESS STANDARD DEVELOPMENT Final Report, 5 Dec. 1988 - 5 Apr. 1991
Job J. Shaw and Stephen Musselman 5 Apr. 1991 36 p
(Contract F33657-88-C-2168)
(AD-A242207; SIMTEC/TR-91-01; ASD-TR-91-5011) Avail: NTIS HC/MF A03 CSCL 05/6

The Simulator Integrity Program is a component of the overall Air Force initiatives to improve the quality, performance, scheduling and supportability of Aircrew Training Equipment. This program focuses on the quality, timeliness, currency, and maintenance of the technical information (source data) generated in the weapon system organizations and used in the training equipment development and support organizations. In accordance with the Statement of Work for the Simulator Data Integrity Program this report documents the methodology, findings, accomplishments, conclusions and recommendations associated with the development, review, and introduction of the principal product of this effort, Military Standard-Aircrew Training Equipment Source Data Process Standard MIL-STD-XXXX, October 1990. A general description of the overall effort is provided in Appendix 1. GRA

N92-19675*# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
A WALK THROUGH THE PLANNED CS BUILDING M.S. Thesis
Delnaz Khorramabadi Oct. 1991 73 p
(Grant NAG2-591)
(NASA-CR-189963; NAS 1.26:189963; UCB/CSD-91/652) Avail: NTIS HC/MF A04 CSCL 14B

Using the architectural plan views of our future computer science building as test objects, we have completed the first stage of a Building walkthrough system. The inputs to our system are AutoCAD files. An AutoCAD converter translates the geometrical information in these files into a format suitable for 3D rendering. Major model errors, such as incorrect polygon intersections and random face orientations, are detected and fixed automatically. Interactive viewing and editing tools are provided to view the results, to modify and clean the model and to change surface attributes. Our display system provides a simple-to-use user interface for interactive exploration of buildings. Using only the mouse buttons, the user can move inside and outside the building and change floors. Several viewing and rendering options are provided, such as restricting the viewing frustum, avoiding wall collisions, and selecting different rendering algorithms. A plan view of the current floor, with the position of the eye point and viewing direction on it, is displayed at all times. The scene illumination can be manipulated, by interactively controlling intensity values for 5 light sources. Author

N92-19940# Sydney Univ. (Australia). School of Civil and Mining Engineering.
DEVELOPMENT OF A WIND CHAMBER FOR MODEL TESTING OF TORNADO FORCES ON STRUCTURES
R. D. Watkins and D. L. Beneke May 1991 23 p
(PB92-104165; R-638) Avail: NTIS HC/MF A03 CSCL 14B

The aim of the study was to investigate the possibility of modeling the most significant features of volcanoes with respect to their effects at near-ground level. Tornadoes are typically local vortex-type phenomena with high-speed rotating cores. Due to their unpredictability, there is a lack of data on the loadings they can impose on structures, and hence it is desirable to provide a convenient and controllable model testing system for such cases. After trying a number of possible arrangements, a satisfactory system has evolved, which is essentially a closed cylindrical chamber that has fluid movement initiated and maintained by a drive unit in its upper part, thereby leaving the lower part free for ground and structural modeling. Author

N92-19978# Sandia National Labs., Albuquerque, NM.
PRESSURE MEASUREMENTS IN HIGH SPEED WATER TUNNELS
E. L. Clark 1992 10 p Proposed for presentation at the 38th

International Instrumentation Symposium, Las Vegas, NV, 26-30 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004891; SAND-91-2851C; CONF-920460-1) Avail: NTIS HC/MF A02

The measurement of surface pressures on a body which is submerged in flowing water involves several problems which are not encountered when the test medium is air. Many of these problems exist even if the water velocity is low, and become more severe at higher velocities (45 to 65 ft/sec) where the surface pressure may be low enough for cavitation to occur. Problem areas which are discussed include: (1) hydrostatic pressure, (2) surface tension, (3) orifice errors, (4) thermal effects on surface-mounted transducers, (5) electrical fields, and (6) two-phase phenomena. DOE

N92-19318*# Norwalk State Technical Coll., CT. Dept. of Mathematics.
TRANSIENT STUDY OF A CRYOGENIC HYDROGEN FILLING SYSTEM
Howard Schleier *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 377-410 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-19182# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS OF SUBORBITAL LAUNCH TRAJECTORIES FOR SATELLITE DELIVERY M.S. Thesis
Mark R. Goodell Dec. 1991 102 p
(AD-A244048; AFIT/GA/ENY/91D-8) Avail: NTIS HC/MF A06 CSCL 20/3

A computer simulation program was used to analyze performance of suborbital launch trajectories using a hypersonic NASP derived vehicle for satellite deployment. The trajectory investigated for this project involved satellite deployment as suborbital speeds. To deploy a satellite in this manner, a booster motor is used to insert the payload into orbit while the launch vehicle reenters and returns to earth. A simplified energy analysis was also formulated and used to determine the sensitivity of suborbital trajectory performance to specific design parameters. Results show that suborbital launch trajectories can increase the useful payload to orbit capacity over an identical vehicle flying a 'typical' ascent where both the launch vehicle and payload are inserted into orbit. The amount of time available for payload deployment from a suborbital trajectory was also investigated with results showing that time periods on the order of ten minutes could be used for payload deployment. GRA

N92-19327# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PERTURBATION THEORY FOR RESTRICTED THREE-BODY ORBITS M.S. Thesis
David A. Ross Dec. 1991 104 p
(AD-A243899; AFIT/GA/ENY/91D-7) Avail: NTIS HC/MF A06 CSCL 03/1

A perturbation theory for restricted three-body orbits, using a periodic trajectory as a reference solution, is investigated. The nearly-periodic equations of motions are derived by analogy to a linearization about an equilibrium point. In this case, the linearization produces a set of time-periodic equations of motion that, according to Floquet, are completely solved by a periodic trajectory. The four-dimensional phase space of the restricted three-body problem is the first surveyed for regions of periodic motion, via the surface of section phase plot. Upon extraction of a periodic orbit, nearly-periodic orbits are integrated. The integrated state vector is routinely sampled, and then twice transformed into a new set of variables. The first translates the frame center to the periodic trajectory. The second, or modal transformation, projects the coordinates along their eigenvectors. The transformations are highly useful, since two of the four new variables are constant within a finite region surrounding the periodic reference. Plots of the two variables are offered as an exact representation of a nearly periodic trajectory, while plots of the constants over time, trace the boundaries of the nearly periodic region. GRA

N92-19438# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ORBIT TRANSFER: DYNAMIC ANALYSIS M.S. Thesis
Daniel Levi deFiguei Rodrigues Oct. 1991 209 p In PORTUGUESE; ENGLISH summary
(INPE-5352-TDI/461) Avail: NTIS HC/MF A10

Orbit transfers are analyzed and structural and dynamic aspects not normally presented in the literature are considered. Among others, these aspects involve orbital motion, attitude motion, distribution of torques due to the misalignment of the propulsive force with the center of mass, attitude control and stabilization, and variable thrust magnitude during the transfer. Bibliographic research was done on these topics. Equations of motion relative to the above situations were written. Numerical simulations for representative cases are presented. It is concluded that the aspects presented are of great importance and that they must be included in the mission analysis of real projects. Author

N92-19709# RADEX, Inc., Bedford, MA.
CALCULATION AND MODELING OF THE ATTITUDE FOR THE COMBINED RELEASE AND RADIATION EFFECTS SATELLITE Scientific Report No. 8, Jun. 1989 - Sep. 1991
W. J. McNeil 26 Sep. 1991 53 p
(Contract F19628-89-C-0068)
(AD-A243950; RX-R-91092; PL-TR-91-2239) Avail: NTIS HC/MF A04 CSCL 22/3

Algorithms are presented for the calculation and modeling of the attitude for the Combined Release and Radiation Effects Satellite. Examples of typical attitude behavior are given. Comparisons with fluxgate magnetometer data are used to estimate error in the attitude model under various conditions. It is found that for the vast majority of orbits, error levels are below 2 deg. Immediately after attitude adjustments, errors may reach 10 deg and the orbit following an adjust may have errors of up to 5 deg in very small segments. During these periods, the error level in the model is about the same magnitude as the deviation of the attitude from pure rotation. A description of the dynamical response of the satellite to various mission events is also included as well as a list of mission events through Orbit 800. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-19381*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
OPERATIONALLY EFFICIENT PROPULSION SYSTEM STUDY (OEPSS) DATA BOOK. VOLUME 5: OEPSS FINAL BRIEFING FOR FIRST YEAR STUDY Interim Report, Apr. 1989 - Apr. 1990
George S. Wong and Glen S. Waldrop 14 Aug. 1990 153 p
(Contract NAS10-11568)
(NASA-CR-188753; NAS 1.26:188753; RI/RD90-149-5-Vol-5)
Avail: NTIS HC/MF A08 CSCL 14B

This study was initiated to identify operations problems and cost drivers for current propulsion systems and to identify technology and design approaches to increase the operational efficiency and reduce operations costs for future propulsion systems. To provide readily usable data for the Advanced Launch System (ALS) Program, the results of the Operationally Efficient Propulsion System Study (OEPSS) were organized into a series of OEPSS Data Books. This volume contains the final briefing on the OEPSS first-year effort. This briefing was presented to MSFC as part of an effort to promote greater interaction between the design community and the launch site operator. Author

N92-19485*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
OPERATIONALLY EFFICIENT PROPULSION SYSTEM STUDY (OEPSS) DATA BOOK. VOLUME 2: GROUND OPERATIONS PROBLEMS Interim Report, 24 Apr. 1989 - 24 Apr. 1990
Glen S. Waldrop 24 Apr. 1990 86 p
(Contract NAS10-11568)
(NASA-CR-188750; NAS 1.26:188750; RI/RD90-149-2-Vol-2)
Avail: NTIS HC/MF A05 CSCL 14B

Operations problems and cost drivers were identified for current propulsion systems and design and technology approaches were identified to increase the operational efficiency and to reduce operations costs for future propulsion systems. To provide readily usable data for the ALS program, the results of the OEPSS study were organized into a series of OEPSS Data Books. This volume presents a detailed description of 25 major problems encountered during launch processing of current expendable and reusable launch vehicles. A concise description of each problem and its operational impact on launch processing is presented, along with potential solutions and technology recommendation. Author

N92-19524*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
OPERATIONALLY EFFICIENT PROPULSION SYSTEM STUDY (OEPSS) DATA BOOK. EXECUTIVE SUMMARY Interim Report, Apr. 1989 - Apr. 1990
George S. Wong 24 Apr. 1990 51 p
(Contract NAS10-11568)
(NASA-CR-188754; NAS 1.26:188754;
RI/RD90-149-5-Exec-Summ) Avail: NTIS HC/MF A04 CSCL 14B

The study was initiated to identify operations problems and cost drivers for current propulsion systems and to identify technology and design approaches to increase the operational efficiency and reduce operations costs for future propulsion systems. To provide readily usable data for the Advanced Launch System (ALS) program, the results of the Operationally Efficient Propulsion System Study (OEPSS) were organized into a series of OEPSS Data Books as follows: Volume 1, Generic Ground Operations Data; Volume 2, Ground Operations Problems; Volume 3, Operations Technology; Volume 4, OEPSS Design Concepts; and Volume 5, OEPSS Final Review Briefing, which summarizes the activities and results of the study. Summarized here are the salient results of the first year. A synopsis of each volume listed above is presented. Author

N92-19526*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
OPERATIONALLY EFFICIENT PROPULSION SYSTEM STUDY (OEPSS) DATA BOOK. VOLUME 3: OPERATIONS TECHNOLOGY Interim Report, Apr. 1989 - Apr. 1990
John O. Vilja 24 Apr. 1990 39 p
(Contract NAS10-11568)
(NASA-CR-188751; NAS 1.26:188751; RI/RD90-149-3-Vol-3)
Avail: NTIS HC/MF A03 CSCL 14B

The study was initiated to identify operational problems and cost drivers for current propulsion systems and to identify technology and design approaches to increase the operational efficiency and reduce operations costs for future propulsion systems. To provide readily usable data for the Advanced Launch System (ALS) program, the results of the OEPSS study were organized into a series of OEPSS Data Books. This volume describes operations technologies that will enhance operational efficiency of propulsion systems. A total of 15 operations technologies were identified that will eliminate or mitigate operations problems described in Volume 2. A recommended development plan is presented for eight promising technologies that will simplify the propulsion system and reduce operational requirements. Author

N92-19655# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
APPLICATION OF RAILGUN PRINCIPLE TO HIGH-VELOCITY HYDROGEN PELLET INJECTION FOR MAGNETIC FUSION REACTOR REFUELING
K. Kim Aug. 1991 204 p
(Contract DE-FG02-84ER-52111)
(DE92-004202; DOE/ER-52111/3) Avail: NTIS HC/MF A10

This report contains three documents describing the progress made by the University of Illinois electromagnetic railgun program sponsored by the Office of Fusion Energy of the United States Department of Energy during the period from July 16, 1990 to August 16, 1991. The first document contains a brief summary of the tasks initiated, continued, or completed; the status of major tasks; and the research effort distribution, estimated and actual, during the period. The second document contains a description of the work performed on time resolved laser interferometric density measurement of the railgun plasma-arc armature. The third document is an account of research on the spectroscopic measurement of the electron density and temperature of the railgun plasma arc. DOE

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N92-19461# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A TOP-DOWN PERFORMANCE ANALYSIS OF A PEGASUS-BASED SPACE STRIKE SYSTEM M.S. Thesis
Douglas E. Collins Dec. 1991 100 p
(AD-A243965; AFIT/ENS/GSO/91D-04) Avail: NTIS HC/MF A05 CSCL 15/6

The feasibility of using Pegasus launch vehicle as a conventional weapons platform is examined. Using a top-down approach, the analysis addresses the fundamental question of whether such a system should be considered for development. The measures of effectiveness considered are delivery range, probability of destroying the target, and responsiveness. Each of the measures is assessed at its top-level and analyzed only to the level of

detail needed to address the fundamental question. The study indicates that attaining a high probability of destroying the target requires extremely precise control over the burnout conditions and that the system must be on constant ready standby to achieve short response times. GRA

N92-19319*# Portland State Univ., OR. Dept. of Computer Science.
DEVELOPMENT OF A COMMON USER INTERFACE FOR THE LAUNCH DECISION SUPPORT SYSTEM
Jean C. Scholtz *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 411-440 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 14B

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N92-19098# Aerospace Corp., El Segundo, CA. Engineering Group.
SPACE SHUTTLE OVERHEAD WINDOWS, OPTICAL TESTS Final Report, 1-3 Aug. 1989
Karen P. Scott Jun. 1991 79 p
(Contract F04701-88-C-0089)
(AD-A244064; TR-0091(6508-21)-1; SSD-TR-91-22) Avail: NTIS HC/MF A05 CSCL 20/6

Visual photographic, and interferometric tests were performed on the space shuttle overhead windows to characterize the optical quality of these windows. An Air Force tri-bar target was viewed with an 8-in. telescope and a 5-in. telescope for the photographic and visual tests. A Zygo Mark IV interferometer was used for the interferometric tests. Results showed that the windows significantly degraded the performance of both telescopes. At least a 160 percent degradation in resolution was seen. The results of an independent test conducted by the Armstrong Aerospace Medical Research Laboratory are reviewed and found to corroborate the Aerospace results. GRA

N92-19308*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
HAZARDOUS GAS LEAK ANALYSIS IN THE SPACE SHUTTLE
Ronald G. Barile *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 27-64 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 22B

N92-19310*# University of Central Florida, Orlando. Dept. of Industrial Engineering and Management Systems.
INFORMATION FLOW ANALYSIS OF LEVEL 4 PAYLOAD PROCESSING OPERATIONS
Mary E. Danz *In its* NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 116-140 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N92-19553 Illinois Univ., Urbana-Champaign.
DESIGN METHODOLOGY FOR A NEURAL NETWORK-BASED TELEMETRY MONITOR Ph.D. Thesis
Michael Francis Lembeck 1991 134 p
Avail: Univ. Microfilms Order No. DA9136655

The requirements for an artificial neural network-based system that is capable of fulfilling monitoring and control requirements of future aerospace missions are identified, and its architectural framework is evaluated. Incorporated into this framework are a newly developed training algorithm and the concept of cooperative network architectures. The feasibility of such an approach is assessed for its ability to identify faults in low frequency waveforms and to generate subsequent controlling outputs for a single parameter spacecraft system. Dissert. Abstr.

N92-19762*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DESTINATION-DIRECTED, PACKET-SWITCHING ARCHITECTURE FOR 30/20-GHz FDMA/TDM GEOSTATIONARY COMMUNICATIONS SATELLITE NETWORK
William D. Ivancic and Mary Jo Shalkhauser Feb. 1992 14 p
Previously announced as N92-14204
(NASA-TP-3201; E-6539; NAS 1.60:3201) Avail: NTIS HC/MF A03 CSCL 09F

A destination-directed packet switching architecture for a 30/20-GHz frequency division multiple access/time division multiplexed (FDMA/TDM) geostationary satellite communications network is discussed. Critical subsystems and problem areas are identified and addressed. Efforts have concentrated heavily on the space segment; however, the ground segment has been considered concurrently to ensure cost efficiency and realistic operational constraints. Author

N92-19654# Meteorological Satellite Center, Tokyo (Japan).
IMPROVEMENT OF TELEMETRY WATCHING FUNCTION
Shigeto Miura *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 85-97 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-19188# Applied Technology Associates, Inc., Albuquerque, NM.
STABILIZED SENSOR PLATFORM FOR MANNED SPACE OBSERVATION Final Report
Henry R. Sebesta 31 Oct. 1991 21 p
(Contract F04701-90-C-0071)
(AD-A244132) Avail: NTIS HC/MF A03 CSCL 22/5

This report documents system-level requirements in all applicable areas which need to be considered in the development and design of a stabilized sensor platform. The objective of the platform is to enhance man's ability to use optical instruments and perform observations of ground scenes from orbiting space

vehicles. This report is intended to serve several purposes within the overall plan, namely: (1) Establishes, documents, and provides rationale for technical and operational requirements which the platform design must fulfill; (2) Provides a consolidated source of information, inputs, and reference materials which influence the design approach and technology selections; (3) Allows broad and early exposure of our development baselines for the stabilized sensor platform so that reviewers can identify and feedback any issues or concerns. GRA

N92-19248*# Spectra Research Systems, Inc., Arlington, VA. Operations Div.

TETHERS IN SPACE HANDBOOK, SECOND EDITION

Paul A. Penzo, ed. (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Paul W. Ammann, ed. May 1989 259 p Original contains color illustrations

(Contract NASw-4341)

(NASA-CR-188756; NAS 1.26:188756) Avail: NTIS HC/MF A12; 1 functional color page CSCL 22B

The Tethers in Space Handbook, Second Edition represents an update to the initial volume issued in September 1986. As originally intended, this handbook is designed to serve as a reference manual for policy makers, program managers, educators, engineers, and scientists alike. It contains information for the uninitiated, providing insight into the fundamental behavior of tethers in space. For those familiar with space tethers, it includes a summary of past and ongoing studies and programs, a complete bibliography of tether publications, and names, addresses, and phone numbers of workers in the field. Perhaps its most valuable asset is the brief description of nearly 50 tether applications which have been proposed and analyzed over the past 10 years. The great variety of these applications, from energy generation to boosting satellites to gravity wave detection is an indication that tethers will play a significant part in the future of space development. This edition of the handbook preserves the major characteristics of the original; however, some significant rearrangements and additions have been made. The first section on Tether Programs has been brought up to date, and now includes a description of TSS-2, the aerodynamic NASA/Italian Space Agency (ASI) mission. Tether Applications follows, and this section has been substantially rearranged. First, the index and cross-reference for the applications have been simplified. Also, the categories have changed slightly, with Technology and Test changed to Aerodynamics, and the Constellations category removed. In reality, tether constellations may be applicable to many of the other categories, since it is simply a different way of using tethers. Finally, to separate out those applications which are obviously in the future, a Concepts category has been added. A new section included here on Conference Summaries recognizes the fact that the tether community is growing internationally, and that meetings provide a means of rapid communication and interaction. Finally, the Bibliography section has been considerably updated to include all known references. These are listed by author and by subject and include the papers to be presented at the Third International Conference in May 1989. Author

N92-19253# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.

DIELECTRICAL DISCHARGES, PLASMA PRODUCED, AND FUNCTIONAL ANOMALIES ON SATELLITES [DECHARGES ELECTRIQUES, PLASMA EMIS ET ANOMALIES DE FONCTIONNEMENT SUR SATELLITES]

Leon Levy, A. R. Frederickson, and C. L. Enloe (Air Force Geophysics Lab., Hanscom AFB, MA.) 1991 18 p In FRENCH; ENGLISH summary Sponsored by Direction des Recherches, Etudes et Techniques

(ETN-92-90862) Avail: NTIS HC/MF A03

Many satellites have suffered from anomalies ascribed to charging and discharging reactions with their environment. The plasma expelled in these discharges is studied in the laboratory. Secondary discharges appear in the vicinity of the plasma of the primary discharge. The electrical charge levels required to produce these secondary discharges are calculated. The geometric and volumetric extension of the plasma necessary to give rise to secondary discharges is determined. Ways in which such primary and secondary discharges could be the cause of anomalies are investigated. ESA

N92-19254# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.

THE ROLE OF HIGH PENETRATION ELECTRONS IN PRODUCING ANOMALIES IN SATELLITES Final Report [ROLE DES ELECTRONS ENERGETIQUES (PENETRANTS) DANS LE DECLENCHEMENT D'ANOMALIES SUR SATELLITES. RAPPORT FINAL]

Leon Levy Mar. 1991 45 p In FRENCH

(Contract DRET-89-1454-DS-SR)

(CERT-430300/RF; ETN-92-90863) Avail: NTIS HC/MF A03

Discharge induced anomalies in satellites are studied from an original perspective. Working under the hypothesis that a plasma is the product of a discharge or that it is the vector of discharge propagation, the electric charge of the discharge is measured. Secondary discharges are found at charge levels as low as 50 volts. The plasma ejected and the charge pressure build up that accompany the primary discharges are determined to be the most likely causes of these low energy level secondary discharges. ESA

N92-19467# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

ESTIMATING WEAPON SYSTEM COSTS USING WEIGHT WITH PERFORMANCE HELD CONSTANT: A METHODOLOGY DEMONSTRATION M.S. Thesis

Darrell E. Wallis, Jr. Sep. 1991 137 p

(AD-A243929; AFIT/GCA/LSQ/91S-15) Avail: NTIS HC/MF A07 CSCL 22/2

This study investigated the relationship between unmanned spacecraft subsystem cost and weight with performance held constant. While there is a positive relationship between cost and weight in the data, it was hypothesized that the relationship would be negative if the data were adjusted to reflect costs at constant performance. It included recurring and nonrecurring costs. Principal component factor analysis was used to adjust weight given the performance variables power, design life, and the product of the two which was called total power. The adjusted weights were then re-inserted into the original regression equations for recurring and nonrecurring costs versus weight. The residuals produced from the cost to weight regressions were added back to each new cost to produce data points that were adjusted parallel to the original regression lines. Regression analysis was then performed on the adjusted data points. The results of these regressions did not support the hypothesis made in the research. This is a new technique (no similar literature was found); therefore, further study and more analysis might yet support the hypothesis. GRA

N92-19518# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

PROPULSIVE CAPABILITY OF A REEL-IN TETHER WITH SAFE SEPARATION BETWEEN PAYLOAD AND ORBITER M.S. Thesis

Jay H. Rothhaupt Dec. 1991 73 p

(AD-A244120; AFIT/GA/ENY/91D-10) Avail: NTIS HC/MF A04 CSCL 22/3

This study investigates the use of a massless reel-in tether for propulsion of a payload following deployment from an orbiter. The distance between the payload and orbiter at closest passage is addressed. A literature review revealed several tether concepts, extensive tether research, and numerous mathematical models. However, previous work in the area of reel-in tethers is limited to propulsion feasibility. The reel-in tether is operated following optimum ejection of the payload from the orbiter using a free arc and subsequent full arc. The free arc of zero tether tension provides initial separation. Switching to a full arc of continuously-maximum tension at the optimum time accelerates and propels the payload

until the mission is complete. Tether and winch capabilities are assumed to be satisfactory during the arcs. Families of trajectories are examined for a range of mission times and minimum final payload energy. Families for two ejection speeds provide comparison of propulsion capability, tether length, and minimum separation radius. Safe separation is achievable through variation of the mission duration and/or the ejection speed. GRA

N92-19542*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE TRANSPORTATION ARCHITECTURE: RELIABILITY SENSITIVITIES
A. M. Williams Jan. 1992 55 p
(NASA-TM-103572; NAS 1.15:103572) Avail: NTIS HC/MF A04 CSCL 22B

A sensitivity analysis is given of the benefits and drawbacks associated with a proposed Earth to orbit vehicle architecture. The architecture represents a fleet of six vehicles (two existing, four proposed) that would be responsible for performing various missions as mandated by NASA and the U.S. Air Force. Each vehicle has a prescribed flight rate per year for a period of 31 years. By exposing this fleet of vehicles to a probabilistic environment where the fleet experiences failures, downtimes, setbacks, etc., the analysis involves determining the resiliency and costs associated with the fleet of specific vehicle/subsystem reliabilities. The resources required were actual observed data on the failures and downtimes associated with existing vehicles, data based on engineering judgement for proposed vehicles, and the development of a sensitivity analysis program. Author

N92-19615 Auburn Univ., AL.
ACTIVE VIBRATION CONTROL Ph.D. Thesis
Jiawei Lu 1991 183 p
Avail: Univ. Microfilms Order No. DA9201244

Active vibration control is an important approach to vibration problems in large flexible space structures. These structures will probably be built from lightweight materials with low damping and they will be very flexible due to the thin, large-size elements from which they will be constructed. Vibration in such large space structures may lead to fatigue, instability, and other destructive results. Modal space control and wave control are the two main approaches used in the active vibration control of a distributed parameter system. Herein, wave control approaches applied to a one-dimensional distributed (or lumped) parameter system are studied both experimentally and theoretically. The vibration isolation on a flexible beam undergoing periodic excitation was studied experimentally. The control was applied to isolate the disturbing source. The LMS (least mean squares) adaptive control approach was successfully used. The control model was also studied theoretically. Active vibration control was studied for a string model by applying boundary adsorption to suppress resonance in the string. Both theoretical and experimental results have shown that active vibration isolation and adsorption are good vibration control approaches. Dissert. Abstr.

N92-19632 Howard Univ., Washington, DC.
ISSUES IN CONTROL SYSTEM DESIGN OF LARGE SPACE STRUCTURES Ph.D. Thesis
Mifang Ruan 1991 204 p
Avail: Univ. Microfilms Order No. DA9136273

The proposed large space structures (LSS) possess special characteristics, such as flexibility, low damping, and tightly grouped frequencies of vibration. Those characteristics lead to mathematical difficulties and special issues in the design of the control systems of the structures. The overall field in design of the control systems of LSS is discussed, and particular attention is paid to four special topics: model reduction of 'single input single output' (SISO) systems; model reduction of 'multi input multi output' (MIMO) systems; actuator placement; and spillover reduction. New methods are developed for each of the topics, and those methods can be applied not only to LSS but also to other control systems. A method is developed for model reduction of SISO systems by using an optimization approach. The method reduces the cost function to a quadratic form by presetting the poles of the reduced system, and the computational time is very small. The difficulties which prevent the use of SISO model reduction methods to MIMO systems are discussed. A new method is also developed, which overcomes the difficulties and reduces the cost function to a quadratic form by presetting the poles of the reduced system. Dissert. Abstr.

N92-19670*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LONG DURATION EXPOSURE FACILITY POST-FLIGHT THERMAL ANALYSIS, PART 1
William M. Berrios and Thomas R. Sampair (Lockheed Engineering and Sciences Co., Hampton, VA.) Jan. 1992 534 p
(NASA-TM-104208-Pt-1; NAS 1.15:104208-Pt-1) Avail: NTIS HC/MF A23 CSCL 22B

Results of the post-flight thermal analysis of the Long Duration Exposure Facility (LDEF) mission are presented. The LDEF mission thermal analysis was verified by comparing the thermal model results to flight data from the LDEF Thermal Measurements System (THERM). Post-flight calculated temperature uncertainties have been reduced to under +/- 18 F from the pre-flight uncertainties of +/- 40 F. The THERM consisted of eight temperature sensors, a shared tape recorder, a standard LDEF flight battery, and an electronics control box. The temperatures were measured at selected locations on the LDEF structure interior during the first 390 days of flight and recorded for post-flight analysis. After the LDEF retrieval from Space on 12 Jan. 1990, the tape recorder was recovered from the spacecraft and the data reduced for comparison to the LDEF predicted temperatures. The LDEF mission temperatures were calculated prior to the LDEF deployment on 7 Apr. 1980, and updated after the LDEF retrieval with the following actual flight parameter data: including thermal fluxes, spacecraft attitudes, thermal coatings degradation, and contamination effects. All updated data used for the calculation of post-flight temperatures is also presented in this document. Author

N92-19671*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LONG DURATION EXPOSURE FACILITY POST-FLIGHT THERMAL ANALYSIS, PART 2
William M. Berrios and Thomas R. Sampair (Lockheed Engineering and Sciences Co., Hampton, VA.) Jan. 1992 455 p
(NASA-TM-104208-Pt-2; NAS 1.15:104208-Pt-2) Avail: NTIS HC/MF A20 CSCL 22B

Results of the post-flight thermal analysis for the Long Duration Exposure Facility (LDEF) mission are presented. The LDEF mission thermal analysis was verified by comparing the thermal model results to flight data from the LDEF Thermal Measurements System (THERM). Post-flight calculated temperature uncertainties have been reduced to under +/- 18 F from the pre-flight uncertainties of +/- 40 F. The THERM consisted of eight temperature sensors, a shared tape recorder, a standard LDEF flight battery, and an electronics control box. The temperatures were measured at selected locations on the LDEF structure interior during the first 390 days of flight and recorded for post-flight analysis. After the LDEF retrieval from Space on 12 Jan. 1990, the tape recorder was recovered from the spacecraft and the data reduced for comparison to the LDEF predicted temperatures. The LDEF mission temperatures were calculated prior to the LDEF deployment on 7 Apr. 1980, and updated after the LDEF retrieval with the following actual flight parameter data: thermal fluxes, spacecraft attitudes, thermal coatings degradation, and contamination effects. All updated data used for calculation of post-flight temperatures is also presented in this document. Author

N92-19683# National Inst. of Standards and Technology, Gaithersburg, MD.
HgCdTe DETECTOR RELIABILITY STUDY FOR THE GOES PROGRAM
D. G. Seiler, G. G. Harman, J. R. Lowney, S. Mayo, and W. S. Liggett Sep. 1991 100 p Sponsored by National Oceanic

and Atmospheric Administration, Rockville, MD
(PB92-112382; NISTIR-4687) Avail: NTIS HC/MF A05 CSCL 22B

The results of a special assessment concerning the reliability of certain infrared detectors for the Geostationary Operational Environmental Satellite System are summarized. The data made available by ITT on detector resistances and signals support the conclusions that degradation of some detector responses has occurred, even when the estimated measurement uncertainty is included. Statistical analysis of the 11-micrometer detectors confirm that detector 11-105 decreased in signal with time. The existing data available to NIST is not sufficient to identify uniquely the cause of degradation or unstable behavior present in a number of detectors. NIST's physical examination of several detectors by optical and scanning electron microscopy methods and an examination and analysis of the Detector Measurement Database has yielded several plausible possible mechanisms for the observed degradation. The possible mechanisms are related to the detector fabrication or processing steps and include: incomplete or poor passivation procedures; excess mercury diffusion resulting from the ion-beam milling fabrication step; poor indium electrical contacts produced by the indium-plated fabrication step; and delamination of the ZnS antireflection optical coating. Other observed problems are also discussed. GRA

N92-19727*# National Aeronautics and Space Administration, Washington, DC.
SIXTY-NINE MONTHS IN SPACE: A HISTORY OF THE FIRST LDEF (LONG DURATION EXPOSURE FACILITY)
1990 15 p Original contains color illustrations
(NASA-NP-149; NAS 1.83:149) Avail: NTIS HC/MF A03; 13 functional color pages CSCL 22B

The LDEF project is summarized from its conception, through its deployment, to the return of the experiments. A LDEF chronology and a fact sheet is included. The experiments carried more than 10,000 specimens to gather scientific data and to test the effects of long term space exposure on spacecraft materials, components, and systems. Results will be invaluable for the design of future spacecraft such as Space Station Freedom. Author

N92-19901# Dynacon Enterprises Ltd., Downsview (Ontario).
SATELLITES HARMING OTHER SATELLITES Arms Control Verification Occasional Paper No. 7
Peter C. Hughes Jul. 1991 63 p
(PB91-224022; ISBN-0-662-18863-2; ISSN-0840-772X) Avail: NTIS HC/MF A04 CSCL 22B

A strategy is developed for assessing the harm that one satellite can do to another. A total of 29 modes are identified through which this harm can transpire, and the parameters and characteristics of each are explained. An overall, quantitative index of harm can be calculated (with respect to a nominal target satellite) for any satellite. A detailed verification strategy for each of these harm modes is also worked out. Peaceful space operations for the next 20-year period are surveyed and possible ambiguities noted. Confidence-building measures are also evaluated. The notion of 'keep-out zones' is explored and traditional ideas for such zones are shown to be simplistic and unworkable. A new, 'free space' keep-out zone is proposed. The technical means for verification of a keep-out zone treaty include the well-established practices of satellite tracking and orbit prediction. GRA

N92-20027*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SHIELD SIZING AND RESPONSE EQUATIONS
Eric L. Christiansen 15 Feb. 1991 15 p
(NASA-TM-105527; NAS 1.15:105527) Avail: NTIS HC/MF A03 CSCL 22B

A consolidated list is presented of meteoroid debris shield equations which have been given in the referenced memorandums. In some cases, equations have been updated; thus, this memorandum supersedes reference 1. The equations are presented in two parts: (1) shield sizing equations which are used to produce preliminary estimates of shielding weights; and (2) response equations to describe the impact conditions (projectile size as a function of velocity, density, and impact angle) causing failure of a given shield that are to be used for probability analyses (such as in the modified BUMPER program). Specific equations are given that are applicable for the following types of shields: aluminum Whipple shields; Nextel multishock (MS) shields; and mesh double bumper (MDB) shields. These equations will be updated in the future as warranted by the results of additional HVI tests, analyses, and shield modeling. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-19219*# GenCorp Aerojet, Sacramento, CA.
ORBIT TRANSFER ROCKET ENGINE INTEGRATED CONTROL AND HEALTH MONITORING SYSTEM TECHNOLOGY READINESS ASSESSMENT Final Report, 28 Oct. 1989 - 1 Apr. 1991
R. L. Bickford, F. N. Collamore, M. L. Gage, D. B. Morgan, and E. R. Thomas Feb. 1992 99 p
(Contract NAS3-23772)
(NASA-CR-187122; NAS 1.26:187122; Aerojet-2459-E7) Avail: NTIS HC/MF A05 CSCL 21H

The objectives of this task were to: (1) estimate the technology readiness of an integrated control and health monitoring (ICHM) system for the Aerojet 7500 lbF Orbit Transfer Vehicle engine preliminary design assuming space based operations; and (2) estimate the remaining cost to advance this technology to a NASA defined 'readiness level 6' by 1996 wherein the technology has been demonstrated with a system validation model in a simulated environment. The work was accomplished through the conduct of four subtasks. In subtask 1 the minimally required functions for the control and monitoring system was specified. The elements required to perform these functions were specified in Subtask 2. In Subtask 3, the technology readiness level of each element was assessed. Finally, in Subtask 4, the development cost and schedule requirements were estimated for bringing each element to 'readiness level 6'. Author

N92-19326# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
STATIC PRESSURE MEASUREMENTS OF A LOW POWER ARCJET M.S. Thesis
Kevin P. Talley Dec. 1991 108 p
(AD-A243898; AFIT/GA/ENY/91D-6) Avail: NTIS HC/MF A06 CSCL 20/11

The NASA Lewis 1.2 kilowatt arcjet has been used for a number of performance and lifetime studies. This design was modified to obtain static pressure measurements at several locations along the arcjet nozzle. These measurements were taken at various propellant flow rates over most of the operational envelope of the thruster. Measured static pressure distributions are considerably higher than predicted by ID models and are proportional to the

arc power. A simple thermodynamic model is also compared to the data, and is shown to match the slope of the data while overpredicting the pressure. GRA

N92-19482# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DESIGN OF AN OPTIMUM THRUST NOZZLE FOR A TYPICAL HYPERSONIC TRAJECTORY THROUGH COMPUTATIONAL ANALYSIS M.S. Thesis
David J. Herring Dec. 1991 137 p
(AD-A243870; AFIT/GAE/ENY/91D-11) Avail: NTIS HC/MF A07 CSCL 01/1

An analysis of a planar supersonic nozzle for a NASP type vehicle was performed with a computer program that used the new upwind flux difference splitting (FDS) method. Thrust optimization, off-design performance, and cowl angle parametric analyses were accomplished, using FDS code, an oblique shock wave solver program, and a Scramjet cycle analysis code, at six points on a 1000 PSF maximum dynamic pressure trajectory, for the Mach numbers 7.5, 10.0, 12.5, 15.0, 17.5, and 20.0. Results from the single parameter number range from 7.5 to 20.0; the attachment angles identified as optimum for the respective trajectory points were 38.0, 38.6, 30.0, 24.6, 20.6, and 17.8. From this range of angles, the 20.6 degree nozzle was found to produce the minimum off-design performance losses over the entire trajectory. This deteriorization was based on selection criteria biased toward the higher Mach numbers. Using the 20.6 degree nozzle attachment angle, a cowl angle parametric analysis was performed to determine the extent to which off design performance losses could be recovered. GRA

N92-19707# Phillips Lab., Edwards AFB, CA.
ARCJET FACILITY Final Report, Aug. 1986 - Aug. 1991
Salvador Castillo Sep. 1991 17 p
(AD-A243948; PL-TR-91-3085) Avail: NTIS HC/MF A03 CSCL 21/3

The Phillips Laboratory's Electric Propulsion Laboratory has designed and begun installation of an arcjet research facility. A 5 ft. by 10 ft. chamber with 12 in. quartz windows (eight windows in all) is designed to allow non-intrusive diagnostic research on arcjets. A 6 ft. by 8 ft. endurance test chamber will allow continuous testing of 5 to 100 kilowatt arcjets for up to 1500 hours. Each of the chambers will be equipped with the essential instrumentation to measure thruster operating conditions. This includes thrust, chamber pressure, chamber and propellant temperature, mass flow, current, and voltage. Video cameras will be used for plume visualizations. GRA

N92-19780*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLAR DYNAMIC MODULES FOR SPACE STATION FREEDOM: THE RELATIONSHIP BETWEEN FINE-POINTING CONTROL AND THERMAL LOADING OF THE APERTURE PLATE
Roger D. Quinn (Case Western Reserve Univ., Cleveland, OH.) and Thomas W. Kerslake 1992 20 p Proposed for presentation at the International Solar Energy Conference, Lahaina, HI, 5-9 Apr. 1992; sponsored by ASME
(NASA-TM-104498; E-6109; NAS 1.15:104498) Avail: NTIS HC/MF A03 CSCL 10B

Dynamic simulations of Space Station Freedom (SSF) configured with solar dynamic (SD) power modules were performed. The structure was subjected to Space Shuttle docking disturbances, while being controlled with a 'natural' vibration and tracking control approach. Three control cases were investigated for the purpose of investigating the relationship between actuator effort, SD pointing, and thermal loading on the receiver aperture plate. Transient, one-dimensional heat transfer analyses were performed to conservatively predict temperatures of the multi-layered receiver aperture plate assembly and thermal stresses in its shield layer. Results indicate that the proposed aperture plate is tolerant of concentrated flux impingement during short-lived structural disturbances. Pointing requirements may be loosened and the requirement control torques lessened from that previously specified. Downsizing and simplifying the joint drive system should result in a considerable savings mass. Author

N92-19934*# Akron Univ., OH.
A HIERARCHY FOR MODELING HIGH SPEED PROPULSION SYSTEMS Final Report
Tom T. Hartley and Alex DeAbreu Dec. 1991 20 p
(Grant NAG3-904)
(NASA-CR-186984; NAS 1.26:186984) Avail: NTIS HC/MF A03 CSCL 21H

General research efforts on reduced order propulsion models for control systems design are overviewed. Methods for modeling high speed propulsion systems are discussed including internal flow propulsion systems that do not contain rotating machinery, such as inlets, ramjets, and scramjets. The discussion is separated into four areas: (1) computational fluid dynamics models for the entire nonlinear system or high order nonlinear models; (2) high order linearized models derived from fundamental physics; (3) low order linear models obtained from the other high order models; and (4) low order nonlinear models (order here refers to the number of dynamic states). Included in the discussion are any special considerations based on the relevant control system designs. The methods discussed are for the quasi-one-dimensional Euler equations of gasdynamic flow. The essential nonlinear features represented are large amplitude nonlinear waves, including moving normal shocks, hammershocks, simple subsonic combustion via heat addition, temperature dependent gases, detonations, and thermal choking. The report also contains a comprehensive list of papers and theses generated by this grant. H.A.

N92-19941# Pacific Northwest Lab., Richland, WA.
A LOW-ALPHA NUCLEAR ELECTRIC PROPULSION SYSTEM FOR LUNAR AND MARS MISSIONS
E. P. Coomes and J. E. Dagle Jan. 1992 7 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992
(Contract DE-AC06-76RL-01830)
(DE92-006730; PNL-SA-20133; CONF-920104-24) Avail: NTIS HC/MF A02

The advantages of using electric propulsion are well-known in the aerospace community. The high specific impulse and, therefore, lower propellant requirements make it a very attractive propulsion option for the Space Exploration Initiative (SEI). Recent studies have shown that nuclear electric propulsion (NEP) is not only attractive for the transport of cargo but that fast piloted missions to Mars are possible as well, with alphas on the order of 7.5 kg/kW. An advanced NEP system with a specific power (alpha) of 2.5 kg/kW or less would significantly enhance the manned mission option of NEP by reducing the trip time even further. This paper describes an advanced system that combines the PEGASUS Drive with systems of the Rotating Multimegawatt Boiling Liquid Metal (RMBLR) power system that was developed as part of the DOE multimegawatt program and just recently declassified. In its original configuration, the PEGASUS Drive was a 10-MWe propulsion system. The RMBLR was a 20-MW electric system. By combining the two, a second-generation PEGASUS Drive can be developed with an alpha less than 2.5 kg/kW. This paper will address the technology advancements incorporated into the PEGASUS Drive, the analysis of a fast piloted mission and an unmanned cargo transport Mars mission, and the integration of laser power beaming to provide surface power. DOE

N92-20043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMBUSTION-WAVE IGNITION FOR ROCKET ENGINES
Larry C. Liou 1992 19 p Presented at the 1992 JANNAF Propulsion Meeting, Indianapolis, IN, 24-26 Feb. 1992
(NASA-TM-105545; E-6809; NAS 1.15:105545) Avail: NTIS HC/MF A03 CSCL 21H

The combustion wave ignition concept was experimentally studied in order to verify its suitability for application in baffled sections of a large booster engine combustion chamber. Gaseous

oxygen/gaseous methane (GOX/GH4) and gaseous oxygen/-gaseous hydrogen (GOX/GH2) propellant combinations were evaluated in a subscale combustion wave ignition system. The system included four element tubes capable of carrying ignition energy simultaneously to four locations, simulating four baffled sections. Also, direct ignition of a simulated Main Combustion Chamber (MCC) was performed. Tests were conducted over a range of mixture ratios and tube geometries. Ignition was consistently attained over a wide range of mixture ratios. And at every ignition, the flame propagated through all four element tubes. For GOX/GH4, the ignition system ignited the MCC flow at mixture ratios from 2 to 10 and for GOX/GH2 the ratios is from 2 to 13. The ignition timing was found to be rapid and uniform. The total ignition delay when using the MCC was under 11 ms, with the tube-to-tube, as well as the run-to-run, variation under 1 ms. Tube geometries were found to have negligible effect on the ignition outcome and timing. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N92-19029# Illinois Univ., Chicago. Dept. of Civil Engineering Mechanics and Metallurgy.

THE STROH FORMALISM FOR ANISOTROPIC ELASTICITY WITH APPLICATIONS TO COMPOSITE MATERIALS Final Report, 15 Jun. 1988 - 14 Jun. 1991

T. C. Ting 7 Oct. 1991 6 p

(Contract DAAL03-88-K-0079)

(AD-A244271; ARO-25122.14-MA) Avail: NTIS HC/MF A02 CSCL 11/4

Anisotropic elasticity has been an active research topic since the need of high strength, light weight composites in aerospace industry became apparent. The oldest theory of two dimensional anisotropic elasticity is due to Lekhnitskii. The Lekhnitskii theory is not only outdated, it is inefficient. A new theory, originally due to Stroh and further developed by others, is very powerful. We have extended the Stroh formalism by presenting new identities and sum rules. Using these identities and sum rules, some heretofore unsolved problems are solved and solutions which are available but are in a complex form are converted into a real form. With the solutions in a real form, many new physically interesting phenomena have been discovered. Some of these findings, such as the invariant properties of rotations about the x3 axis, would be useful in design of composite materials. GRA

N92-19057*# Calspan-Buffalo Univ. Research Center, NY.

DEVELOPMENT OF BEM FOR CERAMIC COMPOSITES Annual Interim Status Report No. 4, Jan. - Dec. 1991

D. P. Henry, P. K. Banerjee, and G. F. Dargush (State Univ. of New York, Buffalo.) Dec. 1991 160 p

(Grant NAG3-888)

(NASA-CR-188979; NAS 1.26:188979) Avail: NTIS HC/MF A08 CSCL 11D

It is evident that for proper micromechanical analysis of ceramic composites, one needs to use a numerical method that is capable of idealizing the individual fibers or individual bundles of fibers embedded within a three-dimensional ceramic matrix. The analysis must be able to account for high stress or temperature gradients from diffusion of stress or temperature from the fiber to the ceramic matrix and allow for interaction between the fibers through the ceramic matrix. The analysis must be sophisticated enough to deal with the failure of fibers described by a series of increasingly sophisticated constitutive models. Finally, the analysis must deal with micromechanical modeling of the composite under nonlinear thermal and dynamic loading. This report details progress made towards the development of a boundary element code designed for the micromechanical studies of an advanced ceramic composite. Additional effort has been made in generalizing the implementation to allow the program to be applicable to real problems in the aerospace industry. Author

N92-19084# Minnesota Univ., Minneapolis.

TRANSITIONS AND DEFECTS IN ORDERED MATERIALS: NONLINEAR THEORY, COMPUTATION, AND EXPERIMENT Final Report, 15 Jul. 1988 - 14 Jul. 1991

Richard D. James and Oscar Bruno Sep. 1991 4 p

(Contract DAAL03-88-K-0110)

(AD-A244416; ARO-25428.1-MA) Avail: NTIS HC/MF A01 CSCL 11/4

The research was divided into three different areas: (1) estimation of the overall behavior of strongly heterogeneous composite materials; (2) optical properties of diffraction gratings; and (3) asymptotic behavior of a coalescence problem. The research results are summarized in the final report. GRA

N92-19096# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

TENSILE STRENGTH CHARACTERIZATION OF A METAL MATRIX COMPOSITE WITH CIRCULAR HOLES M.S. Thesis

Jeffrey Rattray Dec. 1991 147 p

(AD-A243894; AFIT/GAE/ENY/91D-24) Avail: NTIS HC/MF A07 CSCL 11/4

Static tensile testing conducted at room temperature and 650 C shows notch sensitivity for a quasi-isotropic lay-up of a titanium alloy metal matrix composite. The specific material used was SCS-6/Beta 21S. Some unnotched specimens were tested and then the diameter-to-width ratio was varied from 0.1 to 0.4. The room temperature unnotched strength is 840 MPa, and the strength falls to less than half this value at 650 C. The off-axis plies of the (0, + or - 45, 90)s lay-up exhibit debonding of the fibers from the matrix at only ten percent of failure stress. This debonding is shown with acetate replicas and acoustic emission. By modeling the debonded plies with the Halpin-Tsai equations, a modulus is calculated for the debonded material which correlates very well with the experimental modulus. A fiber dominated failure exists at both temperatures, but the fiber pullout exists only at 650 C. Etching away the matrix from the 0 fibers showed a small area near the hole where fibers were damaged. The size of this damage zone correlated very well with the critical distance for the Whitney-Nuismer Point Stress failure prediction method. GRA

N92-19284# Advanced Technology Materials, Inc., Danbury, CT.

TITANIUM CARBIDE-GRAPHITE COMPOSITES Final Report, 1 Apr. - 30 Sep. 1991

Delwyn Cummings 8 Nov. 1991 75 p

(Contract DAAL03-91-C-0015)

(AD-A244111; ARO-28452.1-MS-SBI) Avail: NTIS HC/MF A04 CSCL 11/4

Pure titanium carbide, titanium carbide with free graphite, titanium carbide/vanadium carbide alloy with free graphite, and titanium carbide with boron and free graphite were tested for friction and wear at 22, 600, and 900 C. Test pins of the four compositions were machined from ignots prepared from melts. The test pins were drawn across hot pressed titanium carbide wear plates with 5 newtons of normal force. The lowest friction coefficient at 22 C was 0.12. This was obtained with pure titanium carbide. The lowest friction coefficient at 900 C was 0.19. This was obtained with titanium carbide, boron, and free graphite. Titanium carbide based materials offer a great deal of flexibility in terms of possible composite compositions, all of which can be prepared from a

melt. Further development in this area would entail selecting a specific application and performing friction and wear tests to optimize behavior under those load, atmosphere, and sliding speed conditions. GRA

N92-19325# Army Cold Regions Research and Engineering Lab., Hanover, NH.
ENERGY ABSORPTION OF GRAPHITE/EPOXY PLATES USING HOPKINSON BAR IMPACT
Piyush K. Dutta, David Hui, and Magna R. Altamirano Oct. 1991 18 p
(DA Proj. 4A7-62784-AT-42)
(AD-A244256; CRREL-91-20) Avail: NTIS HC/MF A03 CSCL 11/4

This work summarizes the analytical and experimental study on the energy absorption of quasi-isotropic graphite-epoxy composite plates due to the impacting hemispherical penetrator in a Hopkinson bar apparatus. The mechanics of stress wave propagation through the bar and the composite laminate plate are discussed to predict the phenomenological process involved. The experimental data provided the results in terms of force, velocity, and energy of impact at all times during the penetration process occurring in microseconds. It has been been concluded that loss of contact occurs frequently during the penetration process due to the stress wave reflections back and forth in the thickness direction. The damage process seemed to be both velocity and temperature dependent. Below a certain transition velocity the laminate absorbs less energy at low temperature than at high temperature. The reverse is true above this transition velocity. The mechanism of failure tends to change with impact velocity in such a way that progressively less energy is absorbed at higher velocities. GRA

N92-19366# Washington Univ., Seattle. Dept. of Mechanical Engineering.
DYNAMIC BEHAVIOR OF CERAMIC COMPOSITES
A. S. Kobayashi and M. Taya Oct. 1991 8 p
(Contract N00014-87-K-0326)
(AD-A243904; UWA/DME/TR-91/9) Avail: NTIS HC/MF A02 CSCL 11/4

Results obtained from our studies on the toughening mechanism, quantitative fractography and dynamic fracture of ceramics and ceramic matrix composites are summarized in this final report. One of the most significant accomplishments was to quantify, for the first time, the energy dissipation rate in the brittle silicon carbon(sub w)/aluminum oxide ceramic matrix composite (CMC) using moire interferometry together with finite element analysis. The same hybrid experimental-numerical analysis was also used to determine the resistance curve, which compared favorably with the theoretically predicted toughening effect, in titanium boride. A procedure for estimating the percentage areas of transgranular fracture in ceramics and CMC using line scanning profiles of scanning electron microscopy was developed. Larger percentage areas, which were determined by this procedure of transgranular fractures in Al2O3 and SiC(sub w)/Al2O3, were related to rapid crack propagation thus suggesting a micromechanism which reduces the dynamic crack arrest capability of brittle material. A unique bar impact test was developed for clean dynamic fracture testing of ceramics and CMC's and was used to characterize the dynamic fracture responses of Al2O3 and SiC(sub w)/Al2O3. GRA

N92-19415# Construcciones Aeronauticas S.A., Madrid (Spain). Div. de Proyectos.
COMPARISON OF BEHAVIOR TO PERFORATION IMPACT OF CARBON FIBER AND ALUMINUM ALLOY STRUCTURES [COMPARACION DEL COMPORTAMIENTO FRENTE A IMPACTO DE PERFORACION DE ESTRUCTURAS DE FIBRA DE CARBONO Y ALEACION DE ALUMINIO]
Y. DeFrutos 26 Jun. 1991 29 p In SPANISH
(INFORME-IF-D-ID-599/91; ETN-92-90817) Copyright Avail: NTIS HC/MF A03

Results obtained in an attempt to compare the impact behavior of a carbon fiber and a metallic structure are presented. Values are obtained for the minimum energy produced by perforations in each selected thickness of both types of materials. It is concluded that the metallic element permits more deformation by the impact, before rupture, than the carbon fiber. ESA

N92-19469# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THERMOMECHANICAL FATIGUE OF SCS-6/BETA21-S (0/90)2s COMPOSITE M.S. Thesis Final Report
Dana G. Hanson Dec. 1991 134 p
(AD-A243932; AFIT/GAE/ENY/91D-9) Avail: NTIS HC/MF A07 CSCL 11/4

The objective of this study was to investigate the material behavior of SCS-6/Beta21-S (0/90)2s in a thermomechanical fatigue environment. Samples of the SCS-6/Beta21-S composite were subjected to in-phase and out-of-phase cyclic loading; four samples were tested under in-phase conditions and eight samples were tested under out-of-phase conditions. Stress, temperature, and total strain values were acquired during the test sequence and analyzed for indication of possible trends. Experimental results indicated in-phase specimen possessed shorter fatigue lives then their out-of-phase counterparts above the static first ply failure of the matrix. The out-of-phase specimen showed a shorter fatigue life below the first ply failure. The examination of the strain change, modulus change, fractography, and metallography of the in-phase test specimens suggests a fracture mechanism that is fiber dominated. The investigation of these parameters, for the out-of-phase test specimens, indicates the fracture mechanism may be matrix dominated. Additional analysis, using a linear life fraction model and a cumulative damage model, further suggests two parameters govern the fatigue life of SCS-6/Beta21-S. Both models indicate the maximum stress or strain parameter of the 0 degree fibers provides reasonable correlation for life prediction and damage accumulation for an in-phase environment. The load range and modulus provide reasonable correlation for the life prediction and damage for out-of-phase test specimen. GRA

N92-19483# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FATIGUE BEHAVIOR AND FAILURE MECHANISMS OF CENTRALLY NOTCHED (0)8 AND ((0/90)2)(S) SILICON CARBIDE REINFORCED ALUMINOSILICATE GLASS M.S. Thesis Final Report
William R. Moschelle Dec. 1991 164 p
(AD-A243879; AFIT/GAE/ENY/91D-19) Avail: NTIS HC/MF A08 CSCL 11/4

Unidirectional and bidirectional notched laminates of silicon carbides/1723 were fatigue tested under tensile-tensile loading with a load ratio of 0.1. The notch, a hole, was determined to have a significant effect on 0(sub 8) specimens. Matrix cracking developed near the theoretical maximum stress concentration points on the hole propagating parallel to the fibers, in the load direction, followed by fiber breakage. (0/90 sub 2) (sub S) specimens were found to be notch insensitive. Damage modes for this lay-up were transverse ply matrix cracking, delamination and fiber breakage in the longitudinal plies which led to specimen failure. Several existing analytical models were then applied to these laminates to predict fatigue life. GRA

N92-19506# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THERMOMECHANICAL FATIGUE CHARACTERIZATION OF AN ANGLE PLY METAL MATRIX COMPOSITE M.S. Thesis
Wade H. Vaught Dec. 1991 133 p
(AD-A243871; AFIT/GAE/ENY/91D-21) Avail: NTIS HC/MF A07 CSCL 11/4

An investigation was conducted to study the thermomechanical fatigue (TMF) response of a + or - 45(2s) angle ply SCS-6/titanium-15-3 metal matrix composite (MMC). Load controlled in-phase TMF experiments were performed over the temperature range 149-427 C, with a cycle frequency of 0.02 Hz. Test equipment included a high temperature extensometer, quartz

lamp radiative heaters controlled by a Micricon thermal control unit and TMF test control software, MATE263. Stress and strain hysteresis, total strain and stiffness were monitored to characterize material behavior. Large plastic deformations were observed in all specimens, with total failure strains ranging from 7 to 13 percent. It was observed that the total strain to failure was proportional to the maximum applied cycle stress. Damage mechanisms, studied using edge replication and optical and scanning electron microscopy, showed transverse microcracks originating at the fiber-matrix interface and slip bands and fiber sliding in the matrix. Three phases during fatigue life were observed in the tested specimens: (1) interface damage; (2) matrix hardening; and (3) matrix damage. Cold working of the matrix was a probable factor in the matrix hardening. The fibers did not affect the fatigue behavior which was dominated by matrix response. GRA

N92-19595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TOWARDS THE DEVELOPMENT OF MICROMECHANICS EQUATIONS FOR CERAMIC MATRIX COMPOSITES VIA FIBER SUBSTRUCTURING
P. L. N. Murthy and C. C. Chamis Feb. 1992 21 p
(NASA-TM-105246; E-6574; NAS 1.15:105246) Avail: NTIS HC/MF A03 CSCL 11D

A generic unit cell model which includes a unique fiber substructuring concept is proposed for the development of micromechanics equations for continuous fiber reinforcement ceramic composites. The unit cell consists of three constituents: fiber, matrix, and an interphase. In the present approach, the unit cell is further subdivided into several slices and the equations of micromechanics are derived for each slice. These are subsequently integrated to obtain ply level properties. A stand alone computer code containing the micromechanics model as a module is currently being developed specifically for the analysis of ceramic matrix composites. Towards this development, equivalent ply property results for a SiC/Ti-15-3 composite with 0.5 fiber volume ratio are presented and compared with those obtained from customary micromechanics models to illustrate the concept. Also, comparisons with limited experimental data for the ceramic matrix composite, SiC/RBSN (Reaction Bonded Silicon Nitride) with a 0.3 fiber volume ratio are given to validate the concepts. Author

N92-19598# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique des Materiaux.
BEHAVIOR UNDER COMPRESSION TESTS OF UNIDIRECTIONAL COMPOSITES [COMPORTEMENT EN COMPRESSION DES COMPOSITES UNIDIRECTIONNELS]
I. Grandsire, M. H. Auvray, and P. Sigety Jul. 1991 47 p In FRENCH
(Contract DRET-89-34-001-BC-88)
(ONERA-RT-50/7086-M; ETN-92-90946) Avail: NTIS HC/MF A03

The aim of the study is to provide data on the strength of composite fibers under compression tests. Micromechanical and cross compressive tests performed on fiber composite samples are described. The experiments were carried out on two composite materials, T300/LY556 and the HMS/LY566. The measurements on the HMS/LY556 system were performed by Raman spectroscopy. Differences between both materials' behavior was observed from tests under transmission optical microscopy. The difficulties of measuring the compression stress at failure are pointed out. In order to obtain a realistic approach, tests on unidirectional samples embedded in resin matrix are suggested. ESA

N92-19630 Purdue Univ., West Lafayette, IN.
ELASTIC-PLASTIC BEHAVIOR OF THERMOPLASTIC COMPOSITES UNDER CYCLIC LOADINGS Ph.D. Thesis
Yuting Rui 1991 105 p
Avail: Univ. Microfilms Order No. DA9201392

The experimental results reveal that AS4/PEEK thermoplastic composite exhibits cyclic softening and loading range effect under symmetric cycles of strain or stress, and shows ratchetting effect under unsymmetric cycles of strain. The cyclic softening, loading range effect, ratchetting, and mean stress relaxation are anisotropic. Based on the essential features of the material behavior, an elastic-plastic constitutive model is proposed to describe the material response under cyclic loadings. A one-parameter yield surface is used. A one-parameter memory surface is introduced to characterize the loading range effect and to distinguish the deformation process during subsequent loading from the deformation process during initial loading and overloading. Cyclic softening is achieved by the evolution of generalized plastic modulus. The ratchetting effect is modeled in the frame of time-independent cyclic plasticity by the change of the generalized plastic modulus. Good agreement between the model simulations and the experimental data is obtained. The proposed model is applied to form the constitutive relations of laminates with and without thermal stress by using classical lamination theory. Dissert. Abstr.

N92-19645# Oak Ridge National Lab., TN. Applied Technology Div.
DEVELOPMENT OF PERFORMANCE MODELS FOR THICK COMPOSITES IN COMPRESSION
H. W. Blake, H. J. Grimsby, J. M. Starbuck, and D. E. Welch Nov. 1991 114 p
(Contract DE-AC05-84OR-21400)
(DE92-004093; ORNL/ATD-62) Avail: NTIS HC/MF A06

The initial activities and results of an investigation into the failure of thick-section composite cylinders loaded in compression are discussed. The efforts are aimed at the development of models for predicting cylinder performance based on composite material strengths derived from ring and cylinder tests of unidirectional materials. Initial results indicate that existing failure theories are applicable provided that material strength allowables are based on representative tests, and that appropriate solutions for cylinder stresses are used. Both the failure criteria and stress solution must allow for the three-dimensional stress state and for the discrete layer construction. Predictions for an initial test cylinder, which achieved a record pressure in hydrotest, are consistent with the observed performance. Performance model results obtained for a range of laminate constructions indicate this design to be optimum. Improvements in test fixturing also contributed to the record performance for this first cylinder. This work is a three-year project funded from the Oak Ridge National Laboratory seed-money program. DOE

N92-19708# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Light Structures.
LAMDA: MICROCOMPUTER SOFTWARE FOR DIMENSIONING COMPOSITE LAMINATE AND SANDWICH STRUCTURES
O. Saarela 1991 122 p
(PB92-127471; Rept-91-B27; ISBN-951-22-0723-0) Avail: NTIS HC/MF A06 CSCL 11D

Due to the limitations and scarcity of currently available analysis programs for laminated composite materials in constructions, a library of microcomputer software for the integrated design and analysis of laminate structures was developed during the course of the study. Versatility and ease of use were the requirements set for the software. Analyses most often needed in the design of laminate structures can be run with the tools provided in the software package. These include stiffness and strength analyses for laminates and sandwich structures, as well as stability and free vibration analyses for selected beams and plates. Sensitivity analysis tools are provided for studying the effects of structural parameters on the performance of a laminate. The data bank of the software includes typical material data for most common reinforced plies and core materials. Additional material data may be created and stored in data files defined by the user. GRA

N92-19716# Oak Ridge National Lab., TN.
HIGH TEMPERATURE TENSILE AND FATIGUE STRENGTHS OF Si3 N4
K. C. Liu, C. O. Stevens, and C. R. Brinkman 1991 8 p

Presented at the 2nd Conference of the European Ceramic Society, Augsburg, Fed. Republic of Germany, 11-14 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005170; CONF-910908-3) Avail: NTIS HC/MF A02

Uniaxial tensile fracture and cyclic fatigue data are reported for a grade of HIPed Si3N4. The tensile strength was found to be sensitive to stressing rate at temperatures above 1000 C, indicating highly viscoplastic processes were in operation. Both tensile fracture strength and fatigue resistance decreased rapidly as temperature was increased from 1200 to 1370 C. Cycling from low stress to high stress levels in intermittent steps was beneficial to high cycle fatigue strength due to some strengthening mechanism. DOE

N92-19725*# Lockheed Engineering and Sciences Co., Hampton, VA.
MECHANICAL PROPERTIES OF TRIAXIALLY BRAIDED COMPOSITES: EXPERIMENTAL AND ANALYTICAL RESULTS
John E. Masters, Raymond L. Foye, Christopher M. Pastore, and Yasser A. Gowayed (North Carolina State Univ., Raleigh.) Jan. 1992 30 p
(Contract NAS1-19000)
(NASA-CR-189572; NAS 1.26:189572) Avail: NTIS HC/MF A03 CSCL 11D

This paper investigates the unnotched tensile properties of two-dimensional triaxial braid reinforced composites from both an experimental and analytical viewpoint. The materials are graphite fibers in an epoxy matrix. Three different reinforcing fiber architectures were considered. Specimens were cut from resin transfer molded (RTM) composite panels made from each braid. There were considerable differences in the observed elastic constants from different size strain gage and extensometer readings. Larger strain gages gave more consistent results and correlated better with the extensometer readings. Experimental strains correlated reasonably well with analytical predictions in the longitudinal, zero degree, fiber direction but not in the transverse direction. Tensile strength resuits were not always predictable even in reinforcing directions. Minor changes in braid geometry led to disproportionate strength variations. The unit cell structure of the triaxial braid was discussed with the assistence of computer analysis of the microgeometry. Photomicrographs of the braid geometry were used to improve upon the computer graphics representations of unit cells. These unit cells were used to predict the elastic moduli with various degrees of sophistication. The simple and the complex analyses were generally in agreement but none adequately matched the experimental results for all the braids. Author

N92-19784# Akron Univ., OH. Inst. of Polymer Engineering.
MATRIX CRACKING INITIATED BY FIBER BREAKS IN MODEL COMPOSITES
A. N. Gent and C. Wang Dec. 1991 62 p
(Contract N00014-85-K-0222)
(AD-A243152; TR-28) Avail: NTIS HC/MF A04 CSCL 11/4

Fracture of resins in composite materials can be initiated by a tensile break in a fiber. This process has been investigated for a simple model composite, consisting of two inextensible rods placed along the axis of a cylindrical elastic block and touching in the center. The rods represent a broken fiber. Energy release rates (G) were calculated for a circular crack growing outwards from the point where the rod ends separated as they were pulled apart. Results are compared with experimental observations on cracking of a silicone rubber cylinder containing two steel rods. It was found that a crack grew outwards under increasing load until its radius reached a certain size, approximately half way to the surface of the resin cylinder. At this point, G reached a minimum value and then increased. Simultaneously, the crack accelerated and the sample broke. Forces required to propagate the crack were successfully predicted by linear elastic fracture mechanics at all stages of crack growth and for a wide range of fiber and sample radii. In particular, good agreement was obtained with the maximum force that the model system could support, i.e., the breaking load. When the sample was surrounded by a rigid tube, representing neighboring fibers surrounding the broken one, growth of a crack required an increasing load at all stages. The sample finally fractured when the broken fiber pulled out with resin still attached to it. GRA

N92-19797# Lockheed Missiles and Space Co., Palo Alto, CA.
HIGH TEMPERATURE INTERACTIONS OF METALLIC MATRICES WITH CERAMIC REINFORCEMENTS Final Report, 1 Dec. 1987 - 31 Aug. 1991
A. Joshi, T. C. Chou, and J. Wadsworth 31 Aug. 1991 200 p
(Contract F49620-88-C-0021)
(AD-A244026; LMSC-P010621; AFOSR-91-0955TR) Avail: NTIS HC/MF A09 CSCL 11/4

Advanced aerospace systems require low density materials with substantially improved high temperature mechanical properties and oxidation resistance. Metal matrices with ceramic reinforcements offer such potential. The primary objective of this research effort is to develop a scientific understanding of the nature and extent of interactions between these materials at high homologous temperatures. Part of this study is to understand these processes sufficiently well so that diffusion barriers can be selected to control the interaction. Interfacial reactions of silicon carbides, aluminum oxides, and silicon nitrides with selected high temperature metals have been studied at temperatures between 800 and 1200 C for various times. The metal include neodymium and tantalum strong carbide formers, cobalt, nickel, platinum, Ti3Al, and stainless steel. Reactions of the metals with SiC in this temperature range were extensive; various metal sillicides, metal carbides, ternary metal-silicon-carbides, and unreacted carbon were formed as layered reaction products in the reaction zones. Thin films of Al2O3 in the 100 to 500 nm thickness range are shown to be effective in minimizing the reaction between Nb and SiC. GRA

N92-19875# Oak Ridge National Lab., TN.
STEADY-STATE CREEP OF HOT-PRESSED SILICON CARBIDE WHISKER-REINFORCED SILICON NITRIDE
D. A. Koester, R. F. Davis (North Carolina State Univ., Raleigh.), and K. L. More 1991 8 p Presented at the 1st Canadian International Composites Conference and Exhibition, Montreal, Quebec, 4-6 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004461; CONF-9109229-2) Avail: NTIS HC/MF A02

The research reported herein concerns the constant compressive stress creep behavior of a 30 percent by volume SiC whisker-reinforced Si3N4 containing 6.0 percent by weight Y2O3 and 1.5 percent by weight Al2O3 additives. Creep data will be presented and integrated with an examination of the microstructure obtained via transmission electron microscopy (TEM) and scanning electron microscopy (SEM). DOE

N92-19904# European Space Agency, Paris (France).
LOAD TRANSFER BETWEEN FIBER AND MATRIX IN CARBON FIBER REINFORCED PLASTIC COMPOSITES TENSILE BEHAVIOR OF AN EMBEDDED SINGLE FILAMENT SPECIMEN
Didier Jacques (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Jul. 1991 156 p Transl. into FRENCH of Transfert de Charge Entre Fibre et Matrice dans les Composites Carbone-Resine, Comportement en Traction dun Composite Modele Monofilamentaire (Paris, France, ONERA), Sep. 1989 143 p Original language document was announced as N91-11075
(ESA-TT-1230; ONERA-NT-1989-9; ETN-92-90741) Avail: NTIS HC/MF A08

The load transfer between fiber and matrix in carbon/resin composites was studied through the tensile behavior of a single filament composite specimen. This fragmentation test was adapted to the brittle type resins used in the aerospace industry. The results demonstrate the sensitivity of the obtained parameter to any modification of the system (surface condition of the fiber, nature of the matrix, moisture, etc.). An experimental device for tensioning under microscope was constructed in order to study the kinetics of the fragmentation test and in particular the

micromechanism interacting at the interface. In parallel with this, modeling of the fragmentation process allowed the experimental results to be explained and the influence of the system parameters to be revealed. An extension to composites was proposed, showing that the load transfer capability may be useful for the interpolation and optimization of the properties of composites. ESA

N92-19906# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PREDICTION OF DAMAGE OF LAMINATED COMPOSITE STRUCTURES UNDER QUASI-STATIC AND CYCLIC LOADINGS Ph.D. Thesis - Paris VI Univ.
Alain Thionnet 1991 189 p In FRENCH; ENGLISH summary
Translation was announced as ESA-TT-1282
(ONERA-NT-1991-4; ISSN-0078-3781; ETN-92-91025) Avail: NTIS HC/MF A09

The mechanisms of damage by ply failure and free-edge delamination in a laminated plate structure with unidirectional fiber plies are studied. The failure of the ply, described by a single variable defined in terms of physical size of the default, is approached in two ways: meso-macro and micro-macro. The meso-macro approach is written on the equivalent ply of the cracking ply in the damage mechanics sense. The micro-macro approach is based on the statistical aspect of the phenomenon. In both cases, either quasi-static loadings or with fatigue loadings, the multiplication of the cracks in each ply of the structure is simulated. Delamination is studied when it develops symmetrically in a laminated plane plate. The consequences of this degradation on the generalized behavior of the structure, defined in the sense of the rupture mechanics, are evaluated. A model using a thermodynamic formulation leading to a delamination law is written. The analytical character of this model makes it possible to couple this global damage with those due to cracks in each ply of the structure, in the case of a smooth plane plate, and to observe the two types of damage to evolve and interact continuously. In order to study a more complex structure, the model of the two damages is implemented in a finite element program with an all-or-nothing evolution hypothesis of the delamination. Notched plate calculations show a good ability to predict damage zones. ESA

N92-19960# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
PILOT UV-B SPECTROMETER INTERCOMPARISON EXPERIMENT: A PRELIMINARY REPORT
C. Bruce Baker (National Oceanic and Atmospheric Administration, Research Triangle Park, NC.) 1991 12 p
(PB91-240515; EPA/600/D-91/220) Avail: NTIS HC/MF A03 CSCL 07D

The experiment was a preliminary examination of the considerations needed to intercompare ultraviolet spectrometers (UVS). The participants were Univ. of No. Carolina (UNC), Univ. of Florida (UF), National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), Smithsonian Radiation Lab. (SRL), Atmospheric Environment Services (AES), and National Institute for Standards and Technology (NIST). The experiment was held at the NOAA/EPA's environmental measurement facility in Research Triangle Park, NC, and took place 5 to 7 Nov. 1990. The pilot intercomparison was an opportunity to compare available instrumentation, broadband and spectral, for use in monitoring programs. Ultimately the pilot experiment should provide future guidelines for a more complete international intercomparison of instruments, standards, and calibrations. Author

N92-19973# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique des Materiaux.
INFLUENCE OF ELECTROCHEMICAL GRAFTING OF CARBON FIBER SURFACE AMINE FUNCTIONS ON THE MECHANICAL PROPERTIES OF A CARBON EPOXY COMPOSITE [INFLUENCE DU GREFFAGE ELECTROCHIMIQUE DE FONCTIONS AMINEES EN SURFACE DES FIBRES DE CARBONE SUR LES PROPRIETES MECANIQUES D'UN COMPOSITE CARBONE-EPOXY]
G. Dandine and G. Desarmot Nov. 1990 34 p In FRENCH
(Contract DRET-89-34-001)
(ONERA-RT-12/3549-M; ETN-92-91078) Avail: NTIS HC/MF A03

A pilot cell for continuous treating of carbon fibers which allows an important surface nitrogen level to be obtained on fibers already treated commercially (oxidizing treatment) and oiled is presented. Micromechanical and mechanical tests were carried out on the Courtaulds XAU-HS2 (high resistance)-epoxy Narmco 5208 fiber system. The results were compared to those obtained in the same commercially treated fiber (Courtaulds XAS Fiber) related to the same resin. For amine treatment, the values of traction holding (hardened impregnated mesh) and of G(sub IC) are clearly higher than those given by a standard oxidizing treatment without sensitivity loss in the charge transfer value. ESA

N92-20039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRUCTURE-TO-PROPERTY RELATIONSHIPS IN ADDITION CURED POLYMERS. 4: CORRELATIONS BETWEEN THERMO-OXIDATIVE WEIGHT LOSSES OF NORBORNENYL CURED POLYIMIDE RESINS AND THEIR COMPOSITES
William B. Alston 1992 12 p Proposed for presentation at the 203rd National Meeting of the American Chemical Society, Symposium on Advances in Polymer Matrix Composites, San Francisco, CA, 5-10 Apr. 1992
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105553; E-6876; NAS 1.15:105553;
AVSCOM-TR-92-C-002) Avail: NTIS HC/MF A03 CSCL 11D

Relationships are identified between the thermo-oxidative stability (TOS) at 316 C of a wide variety of PMR (polymerization of monomeric reactants) addition cured polyimide resins and their corresponding graphite fiber composites. Weight loss results at 316 C confirmed the expected relationship of increasing aliphatic endcap content with decreasing TOS. Moreover, the resin TOS study also showed an unexpected linear correlation of decreasing weight loss to increasing ratio of benzylic diamine to aliphatic endcap in the range of the stoichiometries studied. Only after long term 316 C aging does the dianhydride used with the benzylic diamines become an additional factor in influencing the amount of PMR resin and composite weight losses. Also, the benzylic systems consistently showed much lower resin and composite weight losses at 316 C than the corresponding nonbenzylic norbornenyl resins and composites, except when the nonbenzylic diamine monomer does not contain a connecting group. Instead, this diamine resulted in a 316 C resin and composite weight loss that was only competitive with benzylic type diamines. Results show excellent correlation between TOS of all graphite fiber PMR composites and resins. Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-19189# Lehigh Univ., Bethlehem, PA. Center for Solid State Studies.
NEW APPROACH TO CHEMICALLY INDUCED SILICON OXIDATION Final Report

Ralph J. Jaccodine and Donald R. Young 1 Oct. 1991 25 p
(Contract DAAL03-88-K-0095)
(AD-A244133; ARO-22459.9-MS) Avail: NTIS HC/MF A03
CSCL 07/4

The project New Approach to Chemically Induced Silicon Oxidation suggested a new and different approach to oxidation by the addition of small concentrations of a fluorine compound to the oxidation strain. This novel approach was successfully carried out within the framework of state-of-the-art oxidation technology. The objectives for the study were divided into four sections and the core elements of these sections are: study of oxidation kinetics with original source dichlorofluorethane, (Study of température, time, volume additions); involves MOS characterization and effect of hot carriers; influence of this process on stacking faults, furnace ambients and other oxidation related effects; and investigate use of other compounds for this purpose. GRA

N92-19279# Yale Univ., New Haven, CT. Dept. of Applied Physics.
NONLINEAR OPTICAL SPECTROSCOPY OF LIQUID DROPLETS: CHEMICAL COMPOSITION WITHIN THE INTERFACE Final Report, 1 Jul. 1987 - 30 Jun. 1991
Richard K. Chang and Marshall B. Long Aug. 1991 15 p
(Contract DAAL03-87-K-0076)
(AD-A244106; ARO-24091.8-EG) Avail: NTIS HC/MF A03
CSCL 07/4

The combustion of liquid propellant spray offers new challenges for optical diagnostics. We have attempted to apply nonlinear optical spectroscopy as an in-situ probe for the determination of the chemical composition of the droplet and the droplet size. Droplets of low molarity ammonium nitrate in water are used as test samples. The simulated Raman scattering (SRS) spectra of the droplets consisted of two peaks at the vibrational-shifted frequencies of the nitrate ions and of the water molecules. The frequency shifts of the SRS from the input laser frequency are equal to the vibrational frequencies. The dominant SRS peaks associated with the nitrate ions and water molecules are noted to consist of a series of equally spaced peaks which are attributed to the morphology-dependent resonances of a droplet. The droplet radius can be accurately deduced from the wavelength spacing of the series of SRS peaks. The SRS intensity ratio of the nitrate peak and the water peak is proportional to the logarithmic ratio of the nitrate concentration and water concentration. The incident laser and SRS intensities inside the droplets are high enough to produce third order sum frequency generation and two-photon absorption. GRA

N92-19332# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
DETERMINATION OF A KINETIC RATE EXPRESSION FOR THE OXIDATION OF A CK SIMULANT OVER A 1 PERCENT PLATINUM/ALUMINA CATALYST Final Report, Mar. 1990 - Feb. 1991
Joseph A. Rossin, Alec Klinghoffer, and David E. Tevault Nov. 1991 60 p
(DA Proj. 1C1-62622-A-553)
(AD-A244259; CRDEC-TR-316) Avail: NTIS HC/MF A04
CSCL 07/3

The complete catalytic oxidation of chloroacetonitrile over a 1 pct. platinum/alumina catalyst was investigated using a fixed bed catalytic reactor. A kinetic rate expression was developed to describe the rate of catalytic oxidation over the temperature range of 275 to 400 C and concentrations ranging from 250 ppm (v/v) to 10,000 ppm in humid air near atmospheric pressure. The rate expression included terms that accounted for inhibition due to the reactant chloroacetonitrile and product acid gases. The rate expression developed in this study was able to accurately predict low effluent concentrations (between 10 and 100 ppm) when challenged with 5,000 and 10,000 ppm chloroacetonitrile. Development of useful technological approaches for separation of Chemical Warfare (CW) agents from air streams to such a level that the product air is breathable is a complex process. Field concentrations of toxic vapors such as hydrogen cyanide, cyanogen chloride and phosgene can exceed 1 pct. in a realistic CW environment. Due to the toxicity of these compounds, an air purification system would be required to remove these gases to levels on the order of a few parts per million (ppm). Thus, concentration reductions in excess of 99.9 pct. may be required. This differs from many industrial and automotive air purification applications where concentration reductions generally do not exceed 90 pct. GRA

N92-19352 National Physical Lab., Teddington (England). Div. of Materials Metrology.
SRM FOR HIGH TEMPERATURE VISCOSITY MEASUREMENTS: RESULTS FOR PHASE 2 OF INTERLABORATORY COMPARISON PROGRAMME
K. C. Mills and N. Machingawuta Aug. 1991 66 p Original contains color illustrations
(NPL-DMM(A)-29; ISSN-0959-2423; ETN-92-91047) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

The results obtained for the Phase 2 measurements for the viscosity of the Standard Reference Material (SRM) provided by the Community Bureau of Reference (BCR) are detailed. These Phase 2 measurements were carried out using a strict protocol and this resulted in a reduced level of scatter in the experimental values reported by the different laboratories. The various results obtained using molybdenum components were found to be in excellent agreement and provide a suitable data base for certification. Two of the four laboratories using viscometers with Pt/Rh components reported viscosity values in excellent agreement with those obtained using Mo components, but values reported by laboratories using graphite components were found to show a high level of variation. ESA

N92-19370# Centre National de la Recherche Scientifique, Paris (France).
THE 15TH INTERNATIONAL CONFERENCE ON PHOTOCHEMISTRY: ABSTRACTS OF INVITED LECTURES AND ORAL AND POSTER CONTRIBUTIONS
Aug. 1991 461 p Conference held in Paris, France, 28 Jul. - 2 Aug. 1991
(Contract DAJA45-91-M-0180)
(AD-A243975; R/D-6610-CH-02) Avail: NTIS HC/MF A20
CSCL 07/4

This volume contains the abstracts of the scientific contributions which have been presented at the XV International Conference on Photochemistry (Paris, July 28 to August 2, 1991). The 10 plenary lectures will be published separately as a special issue of the Journal of Photochemistry which will be sent by the end of this year to each active participant of the Conference. Topics include: Multiphoton spectroscopy of free radicals; The HCO potential energy surface: probes using molecular scattering and photodissociation; Solvation effects on substituted aromatic molecules in supersonic jets; Jet spectroscopy and excited state dynamics of free radicals; Electronic excitation and dissociation of matrix isolated molecules resulting from accumulation of vibrational energy; Vibronically induced chemistry of collisional pairs in a cryogenic matrix; From polyenals to retinal: an electron-spin-echo study of their triplet state; Some solvent effects in exciplexes and tict molecules; A carbene to biradical rearrangement: reaction paths from 1-(8-methyl-naphtyl) carbene to acenaphthene. GRA

N92-19399# National Inst. of Standards and Technology, Boulder, CO. Chemical Engineering Div.
TRANSIENT HYDROGEN HEAT TRANSFER Final Report, Apr. 1986 - Apr. 1989
B. Louie and W. G. Steward Oct. 1991 42 p Prepared in cooperation with FluidTherm Engineering, Boulder, CO
(PB92-116326; NISTIR-3951) Avail: NTIS HC/MF A03 CSCL 07D

Transient heat transfer to liquid hydrogen was investigated. Then, carbon films and Pt foils submerged in liquid hydrogen received stepped inputs of power ranging from 1-42 W/sq m, and the onset of nucleate or film boiling was obtained for each power level. The critical heat flux was found to be approximately 8 W/sq

cm, with the transition to film boiling occurring in times less than 0.001 s. Premature film boiling can be related to the positive temperature coefficient of resistance and the narrowness of the heaters. Thermometric devices and power generation equipment selection are discussed. GRA

N92-19443 National Physical Lab., Teddington (England). Div. of Materials Metrology.
COMMISSION OF THE EUROPEAN COMMUNITIES BCR INFORMATION: CERTIFICATION REPORT ON STANDARD REFERENCE MATERIAL (SRM) FOR HIGH TEMPERATURE VISCOSITY MEASUREMENTS
K. C. Mills, M. Franken, N. Machingawuta, P. Green, C. Broadbent, G. Urbain, R. Scheel, J. Hocevoir, J. N. Pontoire, and T. Iida et al Aug. 1991 75 p Original contains color illustrations
(NPL-DMM(A)-30; ISSN-0959-2423; ETN-92-91048) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

The BCR (Community Bureau of Reference) certification program for a reference material for high temperature viscosity measurements is detailed. A recommended viscosity temperature relationship is given for the Standard Reference Material (SRM) for the calibration of viscometers using molybdenum and platinum contact materials (crucibles and bobs). Calibration with the SRM for viscometers using graphite components cannot be recommended since the viscosities reported by various laboratories using carbon components were prone to considerable variation. ESA

N92-19486*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
APPARATUS AND METHOD FOR CELLULOSE PROCESSING USING MICROWAVE PRETREATMENT Patent Application
Hatice S. Cullingford, Clifford E. George, and George R. Lightsey (Lightsey, George R., Starkville, MS) 5 Jul. 1991 18 p
(NASA-Case-MSC-21936-1; NAS 1.71:MSC-21936-1; US-Patent-Appl-SN-728901) Avail: NTIS HC/MF A03 CSCL 07D

A method for pretreating a cellulosic waste product with microwaves is disclosed as well as a method and apparatus for converting cellulosic waste into soluble saccharides. The invention greatly enhances a reaction rate for enzymatic hydrolysis. A feed mixture of cellulose, water, and acetic acid are irradiated with microwaves at a superatmospheric pressure in an autoclave reaction vessel and the treated cellulose is enzymatically hydrolyzed in a bioreactor. The acid and enzymes are optionally separated for reuse. As a feed stock for the culture of microbes, the sugars can be further processed into ethanol or food protein. High yield, low hazard potential, low energy usage and ready preparation in space of acetic acid and the enzyme makes the present invention well suited for use on long duration space missions. NASA

N92-19489# Technische Univ., Delft (Netherlands).
RETROGRADE CONDENSATION OF LEAN NATURAL GAS: EXPERIMENTAL AND MODELLING RESULTS FOR FOUR BINARY KEY SYSTEMS Ph.D. Thesis
Marinus Petrus Wilhe Rijkers 1991 158 p
(ISBN-90-6275-686-7; ETN-92-90882) Copyright Avail: NTIS HC/MF A08

The phase behavior of four binary systems, each containing the main constituent of natural gas, methane, and a condensable hydrocarbon, is examined. Binary vapor and liquid compositions are measured independently. The experimental techniques used for solubility measurements in the liquid and in the vapor phase are described. The resulting phase diagrams are discussed. Parameters best describing the binary data model are derived from the basic data model. Two equations of state, one widely used in industry and the other in an advanced developing stage, are tested in describing the measurements. The new data is tested and compared with data from other sources. The proposed strategy for predicting condensation behavior of natural gas is reviewed and suggestions with respect to future experimentation and modeling are made. ESA

N92-19546# Bend Research, Inc., OR.
MECHANISM OF HALOGEN ATTACK ON COMPOSITE REVERSE-OSMOSIS MEMBRANES, PHASE 2 Final Report
S. B. McCray, V. A. Burback, D. T. Friesen, W. M. Haley, and R. H. Hanson 25 Jan. 1991 46 p
(Grant NSF ISI-87-00464)
(PB92-113893; NSF-ISI-87-00464-91001) Avail: NTIS HC/MF A03 CSCL 07D

To identify the mechanisms of chlorine interactions with reverse osmosis (RO) membranes and determine the relative importance of these mechanisms in causing flux decline in membranes, researchers studied highly crosslinked polyamide membranes made by an interfacial-polymerization technique. Results of the program indicate that the flux decline is due to a decrease in water sorption by the membrane polymer caused by the uptake of chlorine into the polymer. Three methods of chlorine uptake were identified: N-chlorination of secondary polyamides, N-chlorination of residual amine groups in the polymer, and sorption of chlorine into a membrane polymer. The first of these has the most effect on membrane performance. Membranes made from tertiary polyamides (not subject to N-chlorination) can maintain high fluxes when exposed to chlorine, but do not reject salt well enough to allow their use as seawater desalination membranes. Author

N92-19582# Technische Univ., Delft (Netherlands). Faculty of Chemical Technology and Materials Science.
SUPERCRITICAL FLUID EXTRACTION OF LIQUID HYDROCARBON MIXTURES Ph.D. Thesis
Andre Banier deHaan 1991 160 p Sponsored by Working Party on Supercritical Fluid Processing
(ISBN-90-370-0050-9; ETN-92-90883) Avail: NTIS HC/MF A08

Results of a study on the separation of liquid hydrocarbon mixtures with various supercritical solvents are presented. The equipment and experimental procedure are discussed and the separation of high boiling alkanes and aromatics with supercritical carbon dioxide, ethane, chlorotrifluoromethane and trifluoromethane, are studied to discover whether supercritical solvents can separate alkanes and aromatics on the basis of their difference in chemical structure rather than on their difference in vapor pressure. The thermodynamics is described using the Peng-Robinson equation of state that was used to model the experimental results. For the design of supercritical extraction columns, a mass transfer model for structured packings under supercritical extraction conditions was developed and tested. This model can be used with the thermodynamic model for the design of supercritical extraction and fractionation processes. The design and economics of a process for the fractionation of a mixture containing 25 wt. pct. tetradecane, hexadecane, octadecane and eicosane with carbon supercritical dioxide into its four 99 pct. pure constituents is presented. The results of a study on the development of a process for the extraction of flavors from milkfat with supercritical carbon dioxide are described. ESA

N92-19610# California Univ., Berkeley. Lawrence Berkeley Lab.
ISSUES CONCERNING SOLID STATE DETECTORS FOR EXAFS
C. S. Rossington, R. D. Giauque, and J. M. Jaklevic Oct. 1991 6 p Presented at the Aussois Workshop on Synchrotron X-ray Detectors, Aussois, France, 23-27 Sep. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004173; LBL-31419; CONF-9109322-1) Avail: NTIS HC/MF A02

Fluorescence extended x-ray absorption fine structure spectroscopy (EXAFS) is a commonly used technique in conjunction with x-ray synchrotron radiation for studying the local atomic structure of dilute elements in biological, geological and materials systems. Due to the nature of the EXAFS technique, and the difficulties associated with the detection of low energy x-rays, EXAFS has been used primarily in the energy range above 5 keV. However, there are a number of elements of interest with K- or L-absorption edges below 5 keV, which have not been easily accessible with existing EXAFS instrumentation. Several

characteristics of solid state detectors must be optimized for use in low energy EXAFS measurements. The detector entrance window, or 'dead layer,' must be as thin as possible to minimize the attenuation of the fluorescent signal. The detector spectral backgrounds must be minimized so that the tailing background on the low energy side of the scattered photopeak is as low as possible to maximize the S/N of the fluorescent photopeak. Based on our work, a thin Pd surface barrier contact on a Si(Li) detector offers the thinnest detector dead layer and also the lowest spectral background for the Si(Li) and Ge detectors studied to date. To maximize the S/N, the detectors must be operated at as high a count rate as possible, without compromising detector energy resolution. High count rates can be achieved using multiple detector arrays; close packing of the detector elements can further increase the S/N by utilizing the 'best' portion of the scattered polarized synchrotron beam. DOE

N92-19622# IIT Research Inst., Bartlesville, OK. National Inst. for Petroleum and Energy Research.
DIFFERENTIATION OF PRIMARY, SECONDARY AND TERTIARY AROMATIC AMINES IN FOSSIL FUELS USING TRIFLUOROACYLATION
J. S. Thomson, J. B. Green, S. K. T. Yu, and R. P. Vrana Dec. 1991 14 p
(Contract DE-FC22-83FE-60149)
(DE92-001013; NIPER-564) Avail: NTIS HC/MF A03

An analytical method which distinguishes between primary, secondary, and tertiary amines has been developed. Trifluoroacetic anhydride, with 4-pyrrolidinopyridine as a catalyst, is used to form di- and mono-trifluoroacylated derivatives of primary and secondary aromatic amines, respectively. Tertiary aromatic amines such as quinoline do not react. GC/MS is then used to analyze the derivatized samples. Retention indices and response factors (relative to 4-fluoroaniline) are reported for more than 50 pure compounds known or expected to be present in fossil fuel base fractions. Also, results from the analysis of base fractions from mildly hydrotreated SRC II coal liquids and petroleum-derived light cycle oils will be reported. DOE

N92-19691# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Lab. Associado de Sensores e Materiais.
FIXED-GRID SIMULATION OF PHASE CHANGE PROBLEMS: THE MUSHY-CELL APPROACH
Mauricio Fabbri Jun. 1991 8 p Presented at the 3d Brazilian Thermal Science Meeting, Itapema, Brazil, 10-12 Dec. 1990
(INPE-5260-PRE/1684) Avail: NTIS HC/MF A02

A new technique for the simulation of quasi-equilibrium solidification processes is described. Results are obtained for pure heat conduction problems resembling one-dimensional freezing and bidimensional directional solidification in a rectangular cavity. Some limitations of the method are discussed. Additionally, possible applications in conductive/diffuse/convective phase change situations are outlined. Author

N92-19694*# McCrone Associates, Inc., Westmont, IL.
ANALYSIS OF PARTICULATE CONTAMINATION ON TAPE LIFT SAMPLES FROM THE VETA OPTICAL SURFACES
Mark S. Germani 21 Feb. 1992 26 p
(NASA Order H-11942-D)
(NASA-CR-189918; NAS 1.26:189918; MA-21600) Avail: NTIS HC/MF A03 CSCL 07D

Particulate contamination analysis was carried out on samples taken from the Verification Engineering Test Article (VETA) x-ray detection system. A total of eighteen tape lift samples were taken from the VETA optical surfaces. Initially, the samples were tested using a scanning electron microscope. Additionally, particle composition was determined by energy dispersive x-ray spectrometry. Results are presented in terms of particle loading per sample. D.R.D.

N92-19697# Ames Lab., IA.
REACTIONS OF AN EXCITED STATE AND OF CARBON- AND SULFUR-CENTERED RADICALS WITH TRANSITION METAL COMPLEXES Ph.D. Thesis
P. L. Huston 3 Dec. 1991 148 p
(Contract W-7405-eng-82)
(DE92-005154; IS-T-1600) Avail: NTIS HC/MF A07

The kinetics of the reductive quenching of the (sup 2)E excited state of CrL3(3+) (L = 2,2'-bipyridine, 1,10-phenanthroline and their substituted analogues) by Ti(III) were studied at 25 C in 1.0 M LiCl-HCl. The dependence of the rate on hydrogen ion concentration indicates that both Ti(H2O)6(3+) and (H2O)5Ti(OH)(2+) quench. Alkyl radicals, generated from the photohomolysis of organocobalt complexes, were allowed to react in aqueous solution with (H2O)2CrL(2+) (L = 1,4,8,11-tetra azacyclopentadecane or (15)aneN4). The reaction rates were evaluated by laser flash photolysis, using the known reaction between R* and the methyl viologen radical cation as a kinetic probe. Reactions of thiyl radicals (RS*) have been studied in aqueous solution using laser flash photolysis. One method used in this study involved generating alkyl radicals by photohomolysis of the cobalt-carbon bond in RCo((14)aneN4)(2+) complexes with visible light. The carbon-centered radicals abstract a hydrogen atom from a thiol to form thiyl radicals. DOE

N92-19777# Clemson Univ., SC.
NOVEL DEVELOPMENTS IN ORGANONITROGEN FLUORINE CHEMISTRY FROM CARBON-NITROGEN Final Report, 1 Nov. 1983 - 30 Sep. 1989
Darryl D. DesMarteau 21 Nov. 1991 128 p
(Contract DAAG29-83-K-0173)
(AD-A244426; ARO-20661.16-CH) Avail: NTIS HC/MF A07 CSCL 07/3

The synthesis, reactions, and selected structures of a variety of fluoroorganic compounds of nitrogen were studied. All of the chemistry is based on the reactivity of carbon-nitrogen double and triple bonds with a few examples of analogous sulfur-nitrogen systems. The chemistry is based predominantly on the reactivity of these unsaturated systems with nucleophiles (fluoride ions mainly) and with oxidizing agents (halogens and peroxides). Fluoride ions from MX (M = K, Rb, Cs) attack nitriles to form R(sub x)CF = N(-) anions which are easily oxidized by the halogens F2, Cl2 and Br2 to the respective R(sub x)CF = NX. The resultant imine can be further attacked by fluoride ion forming R(sub x)CF2NX(-) which can be further ionized to R(sub x)CF2NX2 in certain cases if R(sub x) = F, the alkamine anion is also a reactive nucleophile and nuclephilic substitution reactions lead to a variety of novel compounds. The diaziridines are of special interest in this research. GRA

N92-19821# Marathon Oil Co., Littleton, CO.
HYDROGEN SULFIDE DECOMPOSITION INTO HYDROGEN AND SULFUR BY QUINONE CYCLES Annual Report No. 2, Jun. 1990 - May 1991
M. A. Plummer and S. W. Cowley May 1991 20 p
(Contract GRI-5089-260-1779)
(PB91-243071; GRI-91/0224) Avail: NTIS HC/MF A03 CSCL 07D

The HYSULF (trademark) process decomposes hydrogen sulfide using mild conditions. In the process, hydrogen sulfide is first reacted with a quinone in an organic solvent to produce sulfur and hydroquinone. After sulfur removal, hydroquinone is catalytically processed to recover hydrogen and recycle quinone solvent. The produced sulfur is of excellent quality and easily recoverable from the solvent. The organic solvent should eliminate corrosion problems associated with commercial aqueous redox systems which produce only sulfur. Since no air oxidation is used, the sulfite-sulfate salt problems of aqueous systems will be avoided. The purpose of the contract is to develop a better mechanistic understanding of process chemical reactions and economics. This should result in increased quinone conversion and sulfur precipitation rates, in a determination of the effect of carbon dioxide

on first stage chemistry, and the elimination of the anthrone by-product produced in the dehydrogenation step. Author

N92-19822# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
COMBUSTION IN TURBULENT JETS AND BUOYANT FLAMES Annual Report, 1 Jan. - 31 Dec. 1990
P. E. Dimotakis and J. E. Broadwell 24 Jun. 1991 34 p
(Contract GRI-5087-260-1467)
(PB91-240614; GRI-91/0191) Avail: NTIS HC/MF A03 CSCL 21B

Recent results are reported from an ongoing investigation of the entrainment and mixing mechanisms in momentum-dominated turbulent jets, buoyancy-dominated turbulent plumes, and flows which undergo a transition between these two regimes. The investigation also addresses the effects of molecular diffusion rates (Schmidt number) and combustion heat release on these mechanisms and incorporates these mechanisms into practical modeling and predictive techniques for combustion in these flows. The gas-phase, chemically reacting jet experiments in the High Pressure Combustion Facility are completed. The analysis of the results is still in progress as of the end of the reporting period. These experiments investigated the effects of Reynolds number on turbulent jet diffusion flame length, free of buoyancy and radiation effects. In addition, the authors performed a preliminary investigation of buoyancy and chemical kinetic (Damkohler number) effects, against which turbulent jet combustion models may be compared. Their liquid-phase work continues to yield new insights into the behavior of scalar diffusion and the strain-rate field at the smallest turbulent scales. In the collaborative modeling effort with the SANDIA CRF at Livermore, the authors have made progress in incorporating the effects of radiation and buoyancy in their description of turbulent jet diffusion flames and make comparisons between the model results and some recent NOx measurements. Author

N92-19832# Southwest Research Inst., San Antonio, TX. Engine, Fuel, and Vehicle Research Div.
HYDROCARBON REDUCTIONS THROUGH PRECOMBUSTION CHAMBER DESIGN IN A NATURAL GAS LEAN-BURN ENGINE Final Report, Feb. - Oct. 1990
M. Crane Sep. 1991 104 p
(Contract GRI-5089-293-1848)
(PB92-116219; SwRI-3178-2-1; GETA-91-08; GRI-91/0237)
Avail: NTIS HC/MF A06 CSCL 21B

A study was conducted to evaluate the effects of various precombustion chamber design, operating, and control parameters on the exhaust emissions of a natural gas research engine. Analysis of the results showed that engine-out total hydrocarbons and oxides of nitrogen can be reduced, relative to conventional methods, through precombustion chamber design. More specifically, a novel staged prechamber yielded significant reductions in NO(x) and total hydrocarbon emissions by promoting stable ignition while operating with a high percentage of theoretical excess air. Relatively light load and fuel lean operation with the staged prechamber simultaneously reduced baseline NO(x) and hydrocarbons by 47 and 14 percent, respectively. Emissions reductions were realized at other loads and air/fuel ratios to lesser extents. Positive and deleterious effects of natural gas prechamber design on exhaust emissions are identified and explained. Author

N92-19848# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France).
LINEAR BURNING AND OPTIMIZATION OF ROTATING BLADES Final Report [FLAMBEMENT LINEAIRE ET OPTIMISATION DE PALES TOURNANTES. RAPPORT FINAL]
Michel Bernadou and Bernard Lalanne (Turbomeca S.A. - Brevets Szydlowski, Bordes, France) 1991 113 p In FRENCH
(Contract DRET/INRIA-2-87D0600021103011)
(ETN-92-90869) Avail: NTIS HC/MF A06

A general method for analyzing and carrying out numerical simulation of a linear burning of a thin shell of any form, and the problems involved in optimizing the form of these thin shells according to different criteria are discussed. The methods presented are illustrated by various applications of the methods to practical industrial problems. Some of the applications presented involve the geometric specifications for a cylindrical shell of a cooling tower and of a turbine fan blade. ESA

N92-19974# Argonne National Lab., IL.
MICROWAVE PRODUCTION OF HYDROGEN AND SULFUR FROM HYDROGEN SULFIDE WASTES
J. B. L. Harkness and R. D. Doctor 1992 5 p Presented at the American Society of Mechanical Engineers (ASME) Energy Sources Technology Conference and Exhibition, Houston, TX, 26-30 Jan. 1992
(Contract W-31-109-eng-38)
(DE92-005190; ANL/CP-74879; CONF-920122-5) Avail: NTIS HC/MF A01

A waste-treatment process is being developed that uses 'cold' microwave plasma-chemical reactions to split hydrogen sulfide into elemental hydrogen and sulfur. A clean sulfur product can be recovered and sold, while product gases are purified and separated into seams containing hydrogen, hydrogen sulfide for recycle, and the process purge containing carbon dioxide and water. Experiments with pure hydrogen sulfide at 0.5 to 1.5 L/min flow rates and microwave powers of 400 to 1000 W confirmed that conversions of over 90 percent per pass at process energy requirements approaching 5 kcal/mol are possible. Experiments with impurities typical of petroleum refinery waste hydrogen sulfide streams have demonstrated that these impurities are compatible with the plasma dissociation process and that they do not create new waste treatment problems. This technology has a long-term potential for saving 40 to 70 times 10(exp 12) Btu/yr in the refining industry, for an economic savings of $500 million to $1000 million annually. Although the microwave process should show particular advantages for the petroleum refining industry, the low capital costs and modular nature of the new process should make it economically attractive in connection with the small-scale waste-treatment technologies currently used in the natural gas industry. Currently, in the U.S.S.R., a 500-kW demonstration microwave hydrogen sulfide treatment unit operating at near atmospheric pressure is being tested at the natural gas fields in Orenberg. DOE

N92-19981# Northwestern Univ., Evanston, IL. Dept. of Chemical Engineering.
SOLID STATE, SURFACE, AND CATALYTIC STUDIES OF OXIDES
H. H. Kung 20 Dec. 1991 11 p
(Contract DE-FG02-87ER-13725)
(DE92-006720; DOE/ER-13725/5) Avail: NTIS HC/MF A03

Selective oxidation of light alkanes is a potentially important route to convert the less valuable alkanes to more valuable chemicals such as unsaturated hydrocarbons and oxygenated compounds that are used in fuel mixtures and as feedstock. In specific operations, such processes can also be used to remove environmentally hostile chemicals while converting them into useful chemicals. For such processes to be commercially practical, high yields of the desired products must be obtained instead of the thermodynamically most favored products of carbon oxides. The objective of this research is to develop understandings regarding the interaction of molecules with catalytic surfaces and the relationship between the bulk and surface properties of oxides that would lead to the discovery of highly selective catalysts. DOE

N92-19754# Technical Univ. of Lodz (Poland). Inst. of Man-Made Fibers.
DIFFUSION AND AGGREGATION IN WET SPINNING OF VISCOSE FIBERS
Zdzislaw Choinski *In* Polish Academy of Sciences, Theory of Aggregation and Coagulation 2 1990 p 31-40 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-19187# Materials and Electrochemical Research Corp., Tucson, AZ.
THE DEVELOPMENT OF PLASMA SYNTHESIS TO PRODUCE PRE-ALLOYED, ULTRAFINE INTERMETALLIC ALUMINIDE POWERS FOR INJECTION MOLDING Final Report, Jan. - Jul. 1991
James C. Withers, Sumit Guha, and R. O. Loutfy Dec. 1991 127 p
(Contract DAAL04-91-C-0016)
(AD-A244130; MTL-TR-91-47) Avail: NTIS HC/MF A07 CSCL 11/6

Intermetallics offer significant potential in a variety of military applications. Current processing does not produce significantly small particle sizes to permit the injection molding of complex geometry components. In this Phase 1 program, the processes of gas phase plasma reaction and plasma initiated SHS reactions (PSHS) were investigated to produce small intermetallic particles suitable for injection molding. The gas plasma reaction process failed to produce intermetallic powders with a precise stoichiometric control. By contrast, the PSHS process was successful in producing fine, irregular shaped powders of NiAl with excellent control of composition. Both stoichiometry control and capability of alloying with ternary additions was demonstrated for the PSHS process and molded powders were sintered to greater than 96 pct. density in preliminary tests. The PSHS process can be projected to produce particles at attractive economics of $10 to 50/lb. A novel process termed Cathode Arc Transport (CAT) was demonstrated to produce ultra-fine (300 to 500 nm) spherical intermetallic powders. Excellent compositional control was demonstrated in the CAT transfer process to produce alloy powder. Nanometer intermetallic particles offer significant promise to microstructural control to achieve unusual and enhanced mechanical properties. GRA

N92-19224# European Space Agency, Paris (France).
CHEMICAL TREATMENT OF ALUMINIUM ALLOY POWDER SURFACES
Guenter Staniek (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) and Uwe Hoppe Jul. 1991 51 p Transl. into ENGLISH of Chemische Behandlung von Oberflaechenschichten auf Aluminium-Legierungspulvern, Cologne, Fed. Republic of Germany, May 1990 47 p Original language document was announced as N91-11917
(ESA-TT-1240; DLR-FB-90-21; ETN-92-90744) Avail: NTIS HC/MF A04; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 19 deutsche marks

In aluminum alloy powder metallurgy, surface oxides on powder particles act as obstacles to consolidation. These oxides are practically inevitable and degassing in vacuum is applied prior to compaction in order to facilitate consolidation. As an alternative, degassing powders were treated with chemical solutions, dried and extruded. During chemical treatment, the oxide skin on powder particles is completely or partially dissolved and new oxides with improved properties are formed. Consolidation of powders is facilitated and fracture toughness of extrudes is increased. ESA

N92-19285# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
CRACK GROWTH RATE MODELING OF A TITANIUM-ALUMINIDE ALLOY UNDER THERMAL-MECHANICAL CYCLING M.S. Thesis
John J. Pernot Dec. 1991 319 p
(AD-A244119; AFIT/DS/AA/91-3) Avail: NTIS HC/MF A14 CSCL 11/6

A model is developed to predict crack growth rates in a titanium-aluminide alloy under thermal-mechanical fatigue (TMF). This TMF crack growth rate prediction model, which requires only isothermal data to define its parameters, is distinguished from earlier models in two ways. First, it accounts for mechanical-fatigue and environmental crack growth rate contributions, and it also considers a retardation mechanism thought to be caused by creep blunting of the crack tip. This is the first study to account for such a retardation mechanism during TMF. The second uniqueness of the model is that its general form can account for cycle-dependent crack growth rate contributions that are temperature dependent. In addition, a series of isothermal-fatigue and hold-time tests are performed to generate the data base required for model parameters, and TMF tests are used to validate the modeling technique. The model predicts in-phase, as well as 180 deg and 270 deg out-of-phase crack growth rates extremely well, and underpredicts the 90 deg out-of-phase crack growth rates by a factor of two. Two other, more complex TMF cycles are studied, and the predicted crack growth rates correlate well with the experimental data. GRA

N92-19290*# Lockheed Aeronautical Systems Co., Marietta, GA. Research, Technology and Engineering Div.
DEVELOPMENT AND CHARACTERIZATION OF POWDER METALLURGY (PM) 2XXX SERIES Al ALLOY PRODUCTS AND METAL MATRIX COMPOSITE (MMC) 2XXX Al/SiC MATERIALS FOR HIGH TEMPERATURE AIRCRAFT STRUCTURAL APPLICATIONS Final Report
D. J. Chellman, T. B. Gurganus, and J. A. Walker Feb. 1992 87 p
(Contract NAS1-16048)
(NASA-CR-187631; NAS 1.26:187631; LG92ER0022) Avail: NTIS HC/MF A05 CSCL 11F

The results of a series of material studies performed by the Lockheed Aeronautical Systems Company over the time period from 1980 to 1991 are discussed. The technical objective of these evaluations was to develop and characterize advanced aluminum alloy materials with temperature capabilities extending to 350 F. An overview is given of the first five alloy development efforts under this contract. Prior work conducted during the first five modifications of the alloy development program are listed. Recent developments based on the addition of high Zr levels to an optimum Al-Cu-Mg alloy composition by powder metallurgy processing are discussed. Both reinforced and SiC or B4C ceramic reinforced alloys were explored to achieve specific target goals for high temperature aluminum alloy applications. Author

N92-19341# Sandia National Labs., Albuquerque, NM.
ALLOY DESIGN OPTIONS FOR IMPROVEMENT OF THE THERMOMECHANICAL FATIGUE LIFE OF SOLDER JOINTS
D. R. Frear, W. B. Jones, J. W. Morris, Jr., and Z. Mei (California Univ., Berkeley. Lawrence Berkeley Lab.) 1991 32 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contracts DE-AC04-76DP-00789; DE-AC03-76SF-00098)
(DE92-003954; SAND-91-2533C; CONF-911213-20) Avail: NTIS HC/MF A03

In this paper we discuss alloy development options to improve the thermomechanical fatigue behavior of eutectic Sn-Pb solder joints. Eutectic Sn-Pb solder joints fail through the development of a heterogeneous coarsened band of recrystallized and coarsened Pb- and Sn-rich phases. Imposed deformation concentrates solely into this thin region, accelerating fatigue failures. To address this problem, solder alloys are currently being developed which improve the fatigue characteristics of eutectic Sn-Pb solder. New alloys must retain wetting and manufacturability characteristics similar to eutectic Sn-Pb, in addition to improving fatigue durability. The options we present to improve fatigue life include: creating a fine superplastic microstructure, homogenizing the microstructure with small alloy additions, reinforcing the solder with a carbon composite structure, using dispersed second phase precipitates that break up the solder microstructure, and using replacement alloys for eutectic Sn-Pb. DOE

N92-19383# Nuclear Waste Commission of Finnish Power Cos., Helsinki.
HYDROGEN EMBRITTLEMENT OF TITANIUM TESTED WITH FRACTURE MECHANICS SPECIMENS

Irina Aho-Mantila and Paivi Rahko (Technical Research Centre of Finland, Espoo.) Nov. 1990 39 p Sponsored by Teollisuuden Voima Oy
(DE92-610341; YJT-90-17; ISSN-0359-548X) Avail: NTIS HC/MF A03

Titanium is one of the possible canister materials for spent nuclear fuel. The aim of this study is to determine whether the hydrogen embrittlement of titanium could be a possible deterioration mechanism of titanium canisters. This experimental study was preceded by a literature review and an experimental study on crack nucleation. Tests in this study were carried out with hydrogen charged fracture mechanics specimens. The studied hydrogen contents were as received, 100 ppm, 200 ppm, 500 ppm, and 700 ppm and the types of the studied titanium were ASTM Grades 2 and 12. Test methods were slow tensile test (0.027 mm/h) and fatigue test (stress ratio 0.7 or 0.8 and frequency 5 Hz). According to the literature titanium may be embrittled by hydrogen at slow strain rates and cracking may occur under sustained load. In this study, no evidence of hydrogen embrittlement was noticed in slow strain rate tension with bulk hydrogen contents up to 700 ppm. The fatigue tests of titanium Grades 2 and 12 containing 700 ppm hydrogen showed even slower crack growth compared to the as received condition. Very high hydrogen contents well in eccess of 700 ppm on the surface of titanium can, however, facilitate surface crack nucleation and crack growth, as shown in the previous study. DOE

N92-19418# Ames Lab., IA.
STRENGTH, ULTRASONIC AND METALLURGICAL EVALUATION OF DIFFUSION BONDS OF DISSIMILAR MATERIALS Ph.D. Thesis
G. C. Ojard 20 Dec. 1991 150 p
(Contract W-7405-eng-82)
(DE92-005095; IS-T-1566) Avail: NTIS HC/MF A07

Diffusion bonding is a well known metallurgical joining technique which allows materials to be bonded together to near net shape. Diffusion bonds between dissimilar materials are of unique interest due to the complex interactions at the bond line. Previous experimental work has shown that the bond strength is dependent on the extent of interdiffusion between the two base materials. A systematic investigation of diffusion bonding between Cu and Ni was undertaken to study these effects and to find a means of evaluating the bond quality nondestructively. This system was chosen as it exhibits complete solid solubility which yields the simplest metallurgical system of diffusion bonds between dissimilar materials. A large body of work exists on modelling the kinetics of diffusion bonding between similar materials to predict the time for elimination of voids at the bond line. While most bonding conditions, for similar materials, follow the power law creep model, this is not the case for the Cu-Ni system studied. Ultrasonically, the challenge is to measure the extent and uniformity of the interdiffusion layer. Reflection coefficient measurements have been shown not to be sensitive enough to differentiate the samples. A total energy analysis has been shown to be able to differentiate the quality of the Cu-Ni diffusion bonds produced. Thus, this type of analysis appears to be a versatile NDE technique to monitor bond quality in diffusion bonds between dissimilar materials. DOE

N92-19440# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IMPROVEMENT IN DUCTILITY OF THE INTERMETALLIC COMPOUND Ti3Al Ph.D. Thesis - Paris-Sud Univ.
Isabelle Ehrhart 1991 143 p In FRENCH; ENGLISH summary Translation was announced as ESA-TT-1276
(ONERA-NT-1991-6; ISSN-0078-3781; ETN-92-91027) Avail: NTIS HC/MF A07

Adding a beta stabilizing element like vanadium to Ti3Al improves ductility by refining the microstructure and retaining the high temperature beta phase. The beta phase possesses an ordered structure of the B2 type. Its transformation during ageing at 400 and 500 C was studied by transmission electron microscopy. The ordered omega phase which precipitates in beta undergoes a complex reordering reaction over prolonged ageing times. The equilibrium alpha sub 2 phase appears within the beta matrix at higher ageing temperatures. Investigation of ternary Ti3Al + V alloys with a duplex alpha sub 2 + beta structure revealed that the addition of about 10 at.V is required to obtain a certain amount of room temperature ductility. Their tensile strength and elongation to rupture depend on the volume fraction and morphology of the two phases, which can be varied by following different processing routes and subsequent heat treatments. An attempt was made to improve the plasticity of the alpha sub 2 phase by introducing lattice defects in the ordered structure. Deviations from stoichiometry and addition of zirconium and tin were considered. A decrease in aluminum content enhances ductility quite significantly while zirconium improves strength, and tin has no effect. Vanadium additions of more than 4 at. have a detrimental influence on the oxidation resistance of Ti3Al. ESA

N92-19471# Sandia National Labs., Albuquerque, NM.
ANALYSIS OF ULTRASONIC TINNING
P. T. Vianco and F. M. Hosking 22 Nov. 1991 15 p Presented at the National Electronics Products Conference (NEPCON) West, Anaheim, CA, 23-27 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-003948; SAND-91-2661C; CONF-920247-2) Avail: NTIS HC/MF A03

This report examines the use of ultrasonics for solder joining. The objective of this examination is to determine the wettability of tin on oxygen-free, high conductivity (OFHC) copper. The wettability investigations were carried out using a 'point source' ultrasonic horn. DOE

N92-19530# European Space Agency, Paris (France).
NON-EQUILIBRIUM SOLIDIFICATION IN UNDERCOOLED METALLIC MELTS Ph.D. Thesis - Bochum Univ.
Ekkehard Schleip (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) Jul. 1991 136 p Transl. into ENGLISH of Nicht-Gleichgewichtserstarrung unterkuehler Metallschmelzen (Cologne, Fed. Republic of Germany, DLR), May 1990 137 p Original language document was announced as N91-11918
(ESA-TT-1241; DLR-FB-90-23; ETN-92-90745) Avail: NTIS HC/MF A07; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO Postfach, 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 40 DM

Phase selection processes were studied in undercooled iron and Fe(100-x)Ni(x) melts. The solidified modifications were identified by temperature time profiles measured in situ. The results are discussed on the basis of an entropic model for the surface energy between liquid and solid phases which, in the case of the iron nickel alloy, predicts preferred nucleation of the metastable bcc phase. It was shown that a metastable phase can be seeded by touching the undercooled melt with a trigger crystal of suitable catalytic potency. With a new technique, the growth front velocity as a function of undercooling was measured in iron and CuNi melts. The results are compared with the predictions of actual dendritic growth models, especially with respect to deviations from the local thermodynamic equilibrium at the growth front. ESA

N92-19576# Pacific Northwest Lab., Richland, WA.
TENSILE PROPERTY CHANGES OF METALS IRRADIATED TO LOW DOSES WITH FISSION, FUSION, AND SPALLATION NEUTRONS
H. L. Heinisch, M. L. Hamilton, W. F. Sommer, and P. D. Ferguson (Missouri Univ., Rolla.) Nov. 1991 17 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006422; PNL-SA-19472; CONF-911111-24) Avail: NTIS HC/MF A03

Radiation effects due to low doses of spallation neutrons are compared directly to those produced by fission and fusion neutrons. Yield stress changes of pure Cu, alumina dispersion strengthened Cu and AISI 316 stainless steel irradiated at 36-55 C in the Los

Alamos Spallation Radiation Effects Facility (LASREF) are compared with earlier results of irradiations at 90 C using 14 MeV D-T fusion neutrons at the Rotating Target Neutron Source and fission reactor neutrons in the Omega West Reactor. At doses up to 0.04 displacements per atom (dpa), the yield stress changes due to the three quite different neutron spectra correlate well on the basis of dpa in the stainless steel and the Cu alloy. However, in pure Cu, the measured yield stress changes due to spallation neutrons were anomalously small and should be verified by additional irradiations. With the exception of pure Cu, the low dose, low temperature experiments reveal no fundamental differences in radiation hardening by fission, fusion or spallation neutrons when compared on the basis of dpa. DOE

N92-19593# Brookhaven National Lab., Upton, NY.
CHEMISTRY OF INTERMETALLIC HYDRIDES
J. J. Reilly 1991 23 p Presented at the 180th Meeting of the Electrochemical Society, Phoenix, AZ, 13-18 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005000; BNL-46778; CONF-911047-9) Avail: NTIS HC/MF A03

Certain intermetallic hydrides are safe, convenient and inexpensive hydrogen storage compounds. A particular advantage of such compounds is the ease with which their properties can be modified by small changes in alloy composition or preparation. This quality can be exploited to optimize their storage properties for particular applications, e.g., as intermetallic hydride electrodes in batteries. We will be concerned herein with the more important aspects of the thermodynamic and structural principles which regulate the behavior of intermetallic hydrogen systems and then illustrate their application using the archetype hydrides of LaNi5, FeTi and Mg alloys. The practical utility of these classes of materials will be briefly noted. DOE

N92-19611# Pacific Northwest Lab., Richland, WA.
THE INFLUENCE OF HELIUM ON MECHANICAL PROPERTIES OF MODEL AUSTENITIC ALLOYS DETERMINED USING Ni-59 ISOTOPIC TAILORING AND FAST REACTOR IRRADIATIONN
M. L. Hamilton and F. A. Garner Nov. 1991 14 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-004505; PNL-SA-19346; CONF-911111-15) Avail: NTIS HC/MF A03

Tensile testing on model Fe-Cr-Ni alloys removed from four discharges of the Ni-59 isotopic doping experiment in the Fast Flux Test Facility (FFTF) indicates that helium/dpa ratios typical of fusion reactors do not produce changes in the yield strength or elongation that are significantly different from those at much lower helium generation rates. It also appears that tensile properties approach a saturation level that is dependent only on the final irradiation temperature, but not prior temperature history or thermomechanical starting condition. DOE

N92-19612# Pacific Northwest Lab., Richland, WA.
THE EFFECT OF HELIUM ON MICROSTRUCTURAL EVOLUTION AND MECHANICAL PROPERTIES OF Fe-Cr-Ni ALLOYS AS DETERMINED IN A SPECTRAL TAILORING EXPERIMENT
N. Sekimura, F. A. Garner, and R. D. Griffin (Wisconsin Univ., Madison.) Nov. 1991 20 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006420; PNL-SA-19343; CONF-911111-21) Avail: NTIS HC/MF A03

Fe-15Cr-XNi alloys irradiated at both low (0.66 to 1.2) and very high (27 to 58) helium/dpa levels exhibit significantly different levels of strengthening due to an unprecedented refinement of cavity microstructure at the very high helium levels. When compounded with the nickel dependence of helium generation, the cavity distribution for some irradiation conditions and alloy compositions can be driven below the critical radius for bubble-to-void conversion, leading to a delay in swelling. The critical radius also appears to be dependent on the nickel level. The refinement may not have resulted from the high helium levels alone, however but also may have been influenced by differences in displacement rate and temperature history in the two experiments. DOE

N92-19646# Lawrence Livermore National Lab., CA.
SURVEY OF DEGRADATION MODES OF FOUR NICKEL-CHROMIUM-MOLYBDENUM ALLOYS
G. E. Gdowski (KMI Energy, Livermore, CA.) Mar. 1991 67 p
(Contract W-7405-eng-48)
(DE92-004469; UCRL-ID-108330) Avail: NTIS HC/MF A04

This report examines the degradation modes of four Ni-Cr-Mo alloys under conditions relevant to the Yucca Mountain Site Characterization Project (YMP). The materials considered are Alloys C-276, C-4, C-22, and 625 because they have desirable characteristics for the conceptual design (CD) of the high-level radioactive-waste containers presented in the YMP Site Characterization Plan (SCP). The types of degradation covered in this report are general corrosion; localized corrosion, including pitting and crevice corrosion; stress corrosion cracking in chloride environments; hydrogen embrittlement (HE); and undesirable phase transformations due to a lack of phase stability. Topics not specifically addressed are welding concerns and microbiological corrosion. The four Ni-Cr-Mo alloys have excellent corrosion resistance in chloride environments such as seawater as well as in more aggressive environments. They have significantly better corrosion resistance than the six materials considered for the CD waste container in the YMP SCP. (Those six materials are Types 304L and 3161L stainless steels, alloy 825, unalloyed copper, Cu(70)-Ni(30), and 7 percent aluminum bronze.) In seawater, the Ni-Cr-Mo alloys have negligible general corrosion rates and show little evidence of localized corrosion. The four base materials of these alloys are expected to have nearly indistinguishable corrosion resistance in the YMP environments. The strength requirements of the SCP-CD waste container are met by these materials in the annealed condition; in this condition, they are highly resistant to HE. Historically, HE has been noted when these materials have been strengthened (cold-worked) and used in sour gas (H2S and CO2) well service -- conditions that are not expected for the YMP. Metallurgical phase stability may be a concern under conditions favoring: (1) the formation of intermetallics and carbides; and (2) microstructural ordering. DOE

N92-19656# Vanderbilt Univ., Nashville, TN.
ION BEAM ENHANCED ADHESION OF METAL FILMS TO SAPPHIRE SUBSTRATES Ph.D. Thesis
J. E. Pawel May 1991 199 p
(Contracts DE-AC05-76OR-00033; DE-AC05-84OR-21400)
(DE92-004768; DOE/OR-00033/T460) Avail: NTIS HC/MF A09

The adhesion change of iron films to sapphire implanted with different ion species has been investigated. Because the chromium, iron, and nickel ions have nearly the same mass, slight adjustments in the accelerating voltage have ensured that the ion concentration profiles, cascade damage profiles, ionization damage profiles, recoil distributions, and sputtering are all very similar for each type of implantation. Adhesion processes dependent on these mechanisms should therefore be similar for the three ion species. The adhesion of the implanted films was measured quantitatively by a pull test and qualitatively by a scratch test. In every case, the adhesion was compared with that from as-deposited films. There is an adhesion increase with both iron and chromium implantation. No change was apparent after nickel implantation. DOE

N92-19711# National Inst. of Standards and Technology, Gaithersburg, MD. Metallurgy Div.
INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING: METALLURGY DIVISION, TECHNICAL ACTIVITIES 1991. (NAS-NRC ASSESSMENT PANEL FEBRUARY 13-14, 1992) Annual Report, 1 Oct. 1990 - 30 Sep. 1991
E. N. Pugh and S. C. Hardy Dec. 1991 136 p

(PB92-126515; NISTIR-4697) Avail: NTIS HC/MF A07 CSCL 11F

The FY 1991 activities of the Metallurgy Division of the National Institute of Standards and Technology (NIST) are summarized. These activities center upon the structure-processing-properties relations of metals and alloys, methods of measurement, and the generation and evaluation of critical materials data. Efforts comprise studies of metals processing and process sensors; advanced materials, including metal matrix composites, intermetallic alloys, and superconductors; corrosion and electrodeposition; mechanical properties; magnetic materials; and high temperature reactions. GRA

N92-19717# Oak Ridge National Lab., TN.
COMPARISON OF THERMALLY- AND IRRADIATION-INDUCED GRAIN BOUNDARY SEGREGATION IN AUSTENITIC STAINLESS STEELS
E. A. Kenik 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005172; CONF-911202-15) Avail: NTIS HC/MF A02

Segregation at grain boundaries in austenitic stainless steels sensitized by either thermal annealing or irradiation was studied by analytical electron microscopy. Characterization of grain boundary compositions in both types of materials was performed by high spatial resolution (greater than or = 2 nm) X ray microanalysis. Whereas similar chromium depletion is observed in both processes, there are differences in the behavior of the other alloying elements and in the mechanisms responsible for the segregation. In thermal sensitization, the nickel/iron ratio and the silicon level observed at grain boundaries are similar to those for the matrix. In cases where little or no precipitation occurs, cosegregation of phosphorus, chromium, and molybdenum occurs at boundaries and interfaces. For radiation sensitization, radiation-induced segregation (RIS) results in enrichment of nickel, silicon, and, in certain cases, phosphorus and in depletion of iron at grain boundaries. There appears to be some synergism between segregation of nickel and silicon, which increases the magnitude of RIS effects. Grain boundary precipitation is often observed in both thermally- and irradiation-sensitized materials. However, the nature and origins of the two types of precipitation are different. The formation of chromium-enriched grain boundary carbides is the cause of the chromium depletion in thermal sensitization. In contrast, the precipitates produced by irradiation are enriched in nickel and silicon and depleted in chromium relative to the matrix and therefore are the result of RIS. Results for thermal- and radiation-induced segregation in manganese-stabilized austenites are compared to that for nickel-stabilized austenites. DOE

N92-19731# State Univ. of New York, Stony Brook.
CHARACTERIZATION OF ELECTROCHEMICALLY MODIFIED POLYCRYSTALLINE PLATINUM SURFACES Ph.D. Thesis
L. C. Krebs and Takanobu Ishida Dec. 1991 136 p
(Contract DE-FG02-88ER-13855)
(DE92-005553; DOE/ER-13855/6) Avail: NTIS HC/MF A07

The characterization of electrochemically modified polycrystalline platinum surfaces has been accomplished through the use of four major electrochemical techniques. These were chronoamperometry, chronopotentiommetry, cyclic voltammetry, and linear sweep voltammetry. A systematic study on the under-potential deposition of several transition metals has been performed. The most interesting of these were: Ag, Cu, Cd, and Pb. It was determined, by subjecting the platinum electrode surface to a single potential scan between -0.24 and +1.25 V(sub SCE) while stirring the solution, that the electrocatalytic activity would be regenerated. As a consequence of this study, a much simpler method for producing ultra high purity water from acidic permanganate has been developed. This method results in water that surpasses the water produced by pyrocatalytic distillation. It has also been seen that the wettability of polycrystalline platinum surfaces is greatly dependent on the quantity of oxide present. Oxide-free platinum is hydrophobic and gives a contact angle in the range of 55 to 62 degrees. We have also modified polycrystalline platinum surface with the electrically conducting polymer poly-(rho)-phenylene. This polymer is very stable in dilute sulfuric acid solutions, even under applied oxidative potentials. It is also highly resistant to electrochemical hydrogenation. The wettability of the polymer modified platinum surface is severely dependent on the choice of supporting electrolyte chosen for the electrochemical polymerization. Tetraethylammonium tetrafluoroborate produces a film that is as hydrophobic as Teflon, whereas tetraethylammonium perchlorate produces a film that is more hydrophilic than oxide-free platinum. DOE

N92-19795# Colorado School of Mines, Golden. Center for Welding and Joining Research.
NOVEL CONCEPTS IN WELD METAL SCIENCE: ROLE OF GRADIENTS AND COMPOSITE STRUCTURE
D. K. Matlock and D. L. Olson Dec. 1991 73 p
(Contract DE-FG02-87ER-45308)
(DE92-005082; DOE/ER-45308/5) Avail: NTIS HC/MF A04

The effects of compositional and microstructural gradients on weld metal properties are being investigated. Crack propagation in solidified alloy structures is being characterized as to solidification orientation and the profile of the compositional variations. The effects of compositional gradients, are considered based on a thermodynamic analysis, referred to as the Cahn-Hillard analysis, which describes the degree to which a local surface energy is modified by the presence of a compositional gradient. The analysis predicts that both ductile and brittle fracture mechanisms are enhanced by the presence of a composition gradient. Special techniques to produce laboratory samples with microstructures which simulate the composition and microstructure gradients in solidified weld metal are used, along with appropriate mathematical models, to evaluate the properties of the composite weld metals. The composite modeling techniques are being applied to describe the effects of compositional and microstructural gradients on weld metal properties in Ni-Cu alloys. The development of metal matrix composition weld deposits on austenitic stainless steels has been studied. The particulate metal matrix composites were produced with ceramic or refractory metal powder filled cored wire, which was gas tungsten arc and gas metal arc welded. DOE

N92-19856# Wisconsin Univ., Madison.
ORGANOMETALLIC CHEMISTRY OF BIMETALLIC COMPOUNDS
C. P. Casey Jul. 1991 10 p
(Contract DE-FG02-85ER-13406)
(DE92-005339; DOE/ER-13406/6) Avail: NTIS HC/MF A02

This report consists of six sections: heterobimetallic dihydrides, early-late transition metal heterobimetallic compounds, amphiphilic carbene complexes and hydroxycarbene complexes, diiron compounds with bridging hydrocarbon ligands, diphosphine chelates with natural bite angles near 120 degrees, and synthesis and reactions of M = M compounds. DOE

N92-19882# Pacific Northwest Lab., Richland, WA.
SILICON'S ROLE IN DETERMINING SWELLING IN NEUTRON-IRRADIATED Fe-Cr-Ni-Si ALLOYS
N. Sekimura, F. A. Garner, and J. W. Newkirk (Missouri Univ., Rolla.) Nov. 1991 19 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006480; PNL-SA-19389; CONF-911111-27) Avail: NTIS HC/MF A03

Two silicon-modified alloy series, one based on Fe-15Cr-20Ni and another based on Fe-15Cr-25Ni were irradiated at target temperatures between 399 and 649 C in EBR-II. The influence of silicon on swelling is more complex than previously envisioned and indicates that silicon plays two or more competing roles while in solution. Radiation-induced formation of gamma prime Ni3Si precipitates is dependent on silicon and nickel content, as well as temperature. Precipitation of gamma prime appears to play only a minor role in void formation. DOE

N92-19883# Pacific Northwest Lab., Richland, WA.
DETERMINATION OF CREEP COMPLIANCE AND CREEP-SWELLING COUPLING COEFFICIENTS FOR NEUTRON-IRRADIATED TITANIUM-MODIFIED STAINLESS STEEL AT (APPROXIMATELY)400 C
M. B. Toloczko, F. A. Garner, and C. R. Eiholzer (Westinghouse Hanford Co., Richland, WA.) Nov. 1991 9 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006518; PNL-SA-19385; CONF-911111-22) Avail: NTIS HC/MF A02

Irradiation creep data from FFTF-MOTA at approximately 400 C were analyzed for nine 20 percent cold-worked titanium-modified type 316 stainless steels, each of which exhibits a different duration for the transient regime of swelling. One of these steels was the fusion prime candidate alloy designated PCA. The others were various developmental breeder reactor heats. The analysis was based on the assumption that the B(sub 0) + DS creep model applies to these steels at this temperature. This assumption was found to be valid. A creep-swelling coupling coefficient of D approx. 0.6 times 10(exp -2) MPa(exp -1) was found for all steels that had developed a significant level of swelling. This result is in excellent agreement with the results of earlier studies conducted in EBR-II using annealed AISI 304L and also 10 percent and 20 percent cold-worked AISI 316 stainless steels. There appears to be some enhancement of swelling by stress, contradicting an important assumption in the analysis and leading to an apparent but misleading nonlinearity of creep with respect to stress. DOE

N92-19889# Ames Lab., IA.
A NON-CONTAMINATING METHOD FOR PREPARING INTRA-RARE-EARTH ALLOYS CONTAINING VOLATILE AND NON-VOLATILE METALS
B. J. Beaudry and F. C. Laabs 1991 5 p Presented at the Minerals, Metals, and Materials Society (TMS) Annual Meeting and Exhibition, San Diego, CA, 1-5 Mar. 1992
(Contract W-7405-eng-82)
(DE92-000524; IS-M-672; CONF-920305-1) Avail: NTIS HC/MF A01

The preparation of alloys containing one to two percent of the volatile lanthanide metals Sm, Eu, Tm and Yb in the high melting point (HMP) rare earth metals Sc, Y and Lu was accomplished by a vapor deposition, diffusion method without crucible contamination. The method avoids the melting of the HMP metals which would introduce impurities from the crucible generally Ta or W. Plates of the HMP metals were hung from the lid in the upper part of the Ta crucible. The volatile metals were placed on the bottom and the lid welded in place under an atmosphere of helium. By proper selection of the alloying temperature, the effusion of the metal vapors through the helium atmosphere was slow enough to permit diffusion to occur and prevent refluxing of the newly formed alloy. Very volatile metals such as Mg required a Knudsen cells with a suitably size hole to prevent too rapid transfer of the low melting metal. Electron microprobe analysis of a cross-section of the HMP metals showed a homogeneous distribution of the volatile metals. The time and temperature required to obtain a homogeneous rare earth alloy without contamination are given. The use of the Knudsen cell to form magnesium-rare earth alloys is reviewed. DOE

N92-19899# Brookhaven National Lab., Upton, NY.
INTERFACE REACTIONS IN BILAYERS OF ALUMINUM AND NICKEL-CHROMIUM ALLOY
S. M. Heald, Zhengquan Tan, and J. K. D. Jayanetti 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005390; BNL-46962; CONF-911202-27) Avail: NTIS HC/MF A02

Glancing angle EXAFS and x-ray reflectivity are used to study the interface reaction between nickel-chromium alloys and aluminum. The two metals are found to react independently with Al, with the first reactions taking place at temperatures similar to those found for the pure metals. This means that Ni reacts first with Al to form NiAl3, leaving behind a Cr-rich region at the interface. In this Cr-rich region some of the Cr transforms to the bcc structure from the fcc form of the alloy. At higher temperatures Cr reacts to form CrAl7, and there is no evidence for ternary compound formation. Samples were also prepared with a controlled O contamination at the interface, and it inhibits the reaction much the same as for the pure metal cases. The Ni reaction is not identical to the pure sample case, since the presence of Cr slows down the reaction, and inhibits the initial reaction in the as-prepared bilayers. DOE

N92-19958# Bureau of Mines, Washington, DC.
ZINC SOLUBILITY IN SOLID IRON M.S. Thesis
M. E. Myers 1991 78 p
(PB92-112986) Avail: NTIS HC/MF A05 CSCL 11F

The solubility of zinc in solid iron was determined by a static equilibrium method using two different types of equipment. The first apparatus used a sealed and evacuated fused silica capsule, with the zinc and iron at opposite ends of the capsule. The second apparatus used two vertical mullite or alumina tubes. One tube was partly inside the other with the zinc located on top of the inner tube. In both techniques, the temperature of the zinc fixed the partial pressure of zinc in the system. The results indicate that above an iron temperature of about 1200 C and below a p(Zn) of about 1 atm, there is a linear relationship between zinc vapor pressure and zinc content. Therefore, for these conditions, zinc closely approximates Henry's law. The results also indicate that there is little difference between the activity coefficient of zinc in alpha and gamma iron. GRA

N92-19966# Pacific Northwest Lab., Richland, WA.
IRRADIATION CREEP AND CREEP RUPTURE OF TITANIUM-MODIFIED AUSTENITIC STAINLESS STEELS AND THEIR DEPENDENCE ON COLD WORK LEVEL
F. A. Garner, M. L. Hamilton, C. R. Eiholzer, M. B. Toloczko, and A. S. Kumar (Missouri Univ., Rolla.) Nov. 1991 29 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006484; PNL-SA-19959; CONF-911111-26) Avail: NTIS HC/MF A03

A titanium-modified austenitic type stainless steel was tested at three cold work levels to determine its creep and creep rupture properties under both thermal aging and neutron irradiation conditions. Both the thermal and irradiation creep behavior exhibit a complex non-monotonic relationship with cold work level that reflects the competition between a number of stress-sensitive and temperature-dependent microstructural processes. Increasing the degree of cold work to 30 percent from the conventional 20 percent level was detrimental to its performance, especially for applications above 550 C. The 20 percent cold work level is preferable to the 10 percent level, in terms of both in-reactor creep rupture response and initial strength. DOE

N92-19967# Pacific Northwest Lab., Richland, WA.
HIGH RATE SPUTTER DEPOSITION OF WEAR RESISTANT TANTALUM COATINGS
D. W. Matson, M. D. Merz, and E. D. McClanahan Nov. 1991 21 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006489; PNL-SA-19598; CONF-911132-15) Avail: NTIS HC/MF A03

The refractory nature and high ductility of body centered cubic (bcc) phase tantalum makes it a suitable material for corrosion- and wear-resistant coatings on surfaces which are subjected to high stresses and harsh chemical and erosive environments. Sputter deposition can produce thick tantalum films but is prone to forming the brittle tetragonal beta phase of this material. Efforts aimed at forming thick bcc phase tantalum coatings in both flat plate and cylindrical geometries by high-rate triode sputtering

methods are discussed. In addition to substrate temperature, the bcc-to-beta phase ratio in sputtered tantalum coatings is shown to be sensitive to other substrate surface effects. DOE

N92-20001# Oak Ridge National Lab., TN.
HEAVY-SECTION STEEL IRRADIATION PROGRAM: EMBRITTLEMENT ISSUES
W. R. Corwin 1991 29 p Presented at the 19th Nuclear Regulatory Commission (NRC) Water Reactor Safety Information Meeting, Bethesda, MD, 28-30 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005424; CONF-911079-19) Avail: NTIS HC/MF A03

Maintaining the integrity of the reactor pressure vessel (RPV) in a light-water-cooled nuclear power plant is crucial in preventing and controlling severe accidents and the potential for major contamination releases. The RPV is one of only two major safety-related components of the plant for which a duplicate or redundant backup system does not exist. In particular, it is vital to fully understand the degree of irradiation-induced degradation of the RPV's fracture resistance which occurs during service, since without that radiation damage it is virtually impossible to postulate a realistic scenario which would result in RPV failure. For this reason, the Heavy-Section Steel Irradiation (HSSI) Program has been established by the US Nuclear Regulatory Commission (USNRC) to provide a thorough, quantitative assessment of the effects of neutron irradiation on the material behavior, and in particular the fracture toughness properties, of typical pressure vessel steels as they relate to light-water reactor pressure-vessel integrity. Effects of specimen size, material chemistry, product form and microstructure, irradiation fluence, flux, temperature and spectrum, and postirradiation annealing are being examined on a wide range of fracture properties including fracture toughness, crack arrest toughness, ductile tearing resistance, Charpy V-notch impact energy, dropweight nil-ductility temperature, and tensile properties. Models based on observations of radiation-induced microstructural changes using the field ion microprobe and the high resolution transmission electron microscopy provide improved bases for extrapolating the measured changes in fracture properties to wider ranges of irradiation conditions. The principal materials examined within the HSSI program are high-copper welds since their postirradiation properties are most frequently limiting in the continued safe operation of commercial RPVs. DOE

N92-19307*# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
DEVELOPMENT OF AN ACCELERATED TEST METHOD FOR THE DETERMINATION OF SUSCEPTIBILITY TO ATMOSPHERIC CORROSION
John R. Ambrose *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 1-26 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 11F

N92-19760# Polish Academy of Sciences, Warsaw. Inst. of Fundamental Technological Research.
VOID FORMATION AND MICROFRACTURE OF STRAINED METALS
Jerzy Krzeminski *In its* Theory of Aggregation and Coagulation 2 1990 p 165-188 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-19040# Oklahoma State Univ., Stillwater. Dept. of Chemistry.
THEORETICAL STUDIES OF HOMOGENEOUS AND HETEROGENEOUS REACTIONS IN SILICON SYSTEMS Final Report, 1 Nov. 1989 - 31 Oct. 1991
Lionel M. Raff and Donald L. Thompson 19 Nov. 1991 52 p
(Grant AF-AFOSR-0085-89; AF Proj. 2303)
(AD-A244384; AFOSR-91-1021TR) Avail: NTIS HC/MF A04 CSCL 07/2

This report summarizes the results of research conducted under AFOSR support with particular emphasis on investigations carried out during three-year period. The research reviewed includes homogeneous and heterogeneous processes of particular importance in the chemical vapor deposition (CVD) of silicon from silanes and disilanes, the study of chemical processes occurring under conditions of close confinement, non-statistical dynamics and intramolecular energy transfer processes. New methods for (1) obtaining potential energy surfaces for highly complex systems, (2) simulation of the effects of relaxation to the bulk in surface systems, (3) perturbation studies of gas surface scattering, (4) computation of two dimensional surface tunneling rates, (5) highly efficient variational phase space theory calculation of microconical unimolecular reaction rates, and (6) the computation of intramolecular vibrational relaxation rates are also described. GRA

N92-19075# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
DISSOLUTION RATES OF COPOLYMERS BASED ON 4-HYDROXYSTYRENE AND STYRENE
C.-P. Lei, T. Long, S. K. Obendorf, and F. Rodriguez 18 Dec. 1991 14 p
(Contract N00014-85-K-0474)
(AD-A244029; TR-23) Avail: NTIS HC/MF A03 CSCL 07/6

Copolymers were synthesized by free-radical polymerization using 4-acetoxystyrene and styrene in various ratios. These polymers then were hydrolyzed to the corresponding 4-hydroxystyrene (phenol) copolymers. The dissolution rates of the copolymers (using laser interferometry) decreased with a decrease in hydroxyl group content in aqueous developers (sodium hydroxide, potassium hydroxide, and a tetramethylammonium hydroxide based commercial developer). While an increase in pH value enhances the dissolution, an increase in cation size of these hydroxides at constant pH decreases the dissolution rate. The polymers become essentially insoluble in aqueous developers when the content of the monomer containing the hydroxyl group is less than 70 mole percent. The dissolution rate of P(4HS/S) in organic solvents, methyl isobutyl ketone (MIBK), isopropyl alcohol (IPA), and their mixtures, increases as the styrene content increases. However, in IPA, dissolution rate goes through a maximum and then drops down with styrene content greater than 50 mole percent. In mixtures of these two solvents, the polymer dissolves faster than it does in either pure solvent. GRA

N92-19092# Army Lab. Command, Watertown, MA. Material Technology Lab.
A PRELIMINARY EVALUATION OF DIAMOND-LIKE CARBON COATED POLYCARBONATE Final Report
Alex J. Hsieh, Peter G. Dehmer, and Pearl W. Yip Sep. 1991 17 p
(AD-A243849; MTL-TR-91-42) Avail: NTIS HC/MF A03 CSCL 11/9

The deposition of diamond-like carbon (DLC) films on polycarbonate substrate has recently been achieved at room temperature by Diamonex, Inc. via a unique ion beam system. These diamond-like carbon coatings have considerable potential as wear-resistant protective hardcoatings for transparent armor

systems. Aspects of ballistic behavior, abrasion resistance, thermal stability, and chemical resistance of the coating and any influence it has on the impact performance of the polycarbonate substrate were examined in this study. Preliminary results indicate that adhesion between the DLC coating and the polycarbonate substrate is very good. No delamination or peeling of the coating was found on the ballistically tested specimens. In addition, a well-bonded DLC coating did not cause polycarbonate to fail in a brittle fashion. Preliminary results of its inertness to the decontaminant DS2 demonstrate that the DLC coating is capable of protecting polycarbonate from abrasion while maintaining critical agent, decontaminant, and ballistic concerns. GRA

N92-19129# Case Western Reserve Univ., Cleveland, OH. Dept. of Macromolecular Science.

MOLECULAR ENGINEERING OF LIQUID CRYSTAL POLYMERS BY LIVING POLYMERIZATION, 17. CHARACTERIZATION OF POLY(10-((4-CYANO-4'-BIPHENYL) OXY) DECANYL VINYL ETHER)S BY 1-D AND 2-D(SUP 1) H-NMR SPECTROSCOPY

Virgil Percec, Myongsoo Lee, Peter L. Rinaldi, and Vincent E. Litman 30 Oct. 1991 14 p
(Contract N00014-90-J-1828)
(AD-A242400; TR-54) Avail: NTIS HC/MF A03 CSCL 07/6

Since the first examples of mesogenic vinyl ethers and liquid crystalline poly(vinyl ether)s were reported from our laboratory, several research groups became actively engaged in the synthesis of liquid crystalline poly(vinyl ether)s mainly because they can be polymerized by living cationic mechanism. So far, we have elucidated the influence of molecular weight on the phase transitions of poly(omega ((4-cyano 4'-biphenyl)oxy)alkyl vinyl ether)s with alkyl groups from ethyl to undecanyl. Binary copolymerization experiments performed with the same monomers at constant copolymer molecular weight allowed the molecular design of nematic, smectic A and reentrant nematic mesophases. Similar homopolymerization and copolymerization experiments were used to tailor make polymers exhibiting a chiral smectic C mesophase. In addition, it has been shown that many functional mesogenic vinyl ethers can be polymerized by our preferred initiating system CF3SO3H/S(CH3)2 in CH2Cl2(9). The experiments described so far required only a good control over the degree of polymerization and polydispersity of the polymer. GRA

N92-19131# California Univ., San Diego, La Jolla. Dept. of Chemistry.

EARLY-TRANSITION-METAL SILICON COMPOUNDS AND THEIR ROLES IN THE SYNTHESIS OF NEW POLYMERIC AND CERAMIC MATERIALS Final Report, 1 Jun. 1988 - 31 May 1991

T. D. Tilley 31 Oct. 1991 17 p
(Grant AF-AFOSR-0273-88; AF Proj. 2303)
(AD-A243839; AFOSR-91-0944TR) Avail: NTIS HC/MF A03 CSCL 07/6

The objective of this work was to investigate new transition metal silicon complexes as precursors to ceramic materials, or as catalysts for the synthesis of silicon containing polymers. Precursors to metal silicates were based on complexes of the tri(tert-butoxy)siloxy ligand. Very low temperature, clean routes to silicate materials were discovered. The ceramic materials that were investigated in most detail had the compositions MO24SiO2(M = Ti, Zr, Hf). It was shown that these thermolytic methods could be carried out in solution, and used to apply smooth, thin films of the silicate materials. New transition metal silyl complexes were discovered, and some were used in mechanistic studies to demonstrate a mechanism for the d(exp 0) metal-catalyzed dehydrocoupling of silanes to polysilanes. This represents a new polymerization mechanism which shows great promise for the synthesis of new polymers. GRA

N92-19176# Delaware Univ., Newark.

ELEVATED TEMPERATURE BEHAVIOR OF GLASS AND CERAMIC MATRIX COMPOSITES Final Report, 1 Jul. 1987 - 31 May 1991

Tsu-Wei Chou and Azar Parvizi-Majidi Sep. 1991 25 p
(Grant AF-AFOSR-0383-87)
(AD-A244035; AFOSR-91-0948TR) Avail: NTIS HC/MF A03 CSCL 11/4

This research effort can be categorized into three major areas. Section 1 of the report summarizes research on continuous fiber reinforced ceramic matrix composites. A systematic investigation of the damage development and failure behavior of Nicalon silicon carbide fiber reinforced calcium aluminosilicate composites was first conducted through mechanical testing and microscopy. Then, an analytical effort was made to examine the fracture behavior and thermal shock resistance of continuous fiber reinforced ceramic matrix composites. Section 2 is on whisker and/or short fiber reinforced ceramic matrix composites. The effort included analytical modeling of crack deflection and creep behavior of whisker reinforced composites, characterization of fracture mechanisms in whisker/short fiber ceramic composites at elevated temperatures, and experimental investigation of high temperature creep behavior of the SiC(w)/Al2O3 composite system. Section 3 is on processing. Two research efforts have been reported. In one, the kinetics of the chemical vapor infiltration (CVI) process for fabricating continuous fiber reinforced ceramic composites was modelled for both isothermal and forced CVI conditions. In the other effort, sol-gel processing route was used to develop 3-D reinforced textile (woven and braided) ceramic composites. GRA

N92-19202# Texas A&M Univ., College Station. Dept. of Chemistry.

CHROMOPHORE MOTION IN POLYMERS FOR NONLINEAR OPTICS BY SOLID-STATE NMR Technical Report No. 2, 1 Mar. - 30 Nov. 1991

Sharon A. Taylor, David B. Ferguson, and James F. Haw 12 Dec. 1991 12 p
(Contract N00014-91-J-1475)
(AD-A244187) Avail: NTIS HC/MF A03 CSCL 09/1

There is much current interest in polymer materials for nonlinear optical (NLO) applications. These materials are commonly prepared by either dissolving (doping) a suitable NLO chromophore into a glassy or liquid crystalline polymer, or by covalently attaching the chromophore to the polymer host either by direct synthesis or radiative crosslinking. Regardless of the method of preparation, macroscopic orientation of the chromophore must be induced and maintained for efficient second-harmonic generation (SHG) in frequency doubling applications. For the most common use of a glassy polymer host, chromophore orientation is achieved by the process of poling. Briefly, the material is heated above Tg, a strong electric field is applied to orient the chromophores, and the material is cooled below Tg to lock in the orientation before the field is removed. A major problem in polymeric NLO materials is loss of SHG properties over time. For example, in a study of 4-(dimethylamino)- 4'-nitrostilbene in PMMA, Hampsch and coworkers reported that up to 80 percent of the SHG efficiency was lost after 12 h at 298 K. GRA

N92-19245# Cornell Univ., Ithaca, NY. School of Chemical Engineering.

REACTIVE ION ETCHING OF SELECTED POLYMERS IN O2 AND CF4/O2

B. Hand, T. Long, B. C. Dems, and F. Rodriguez 18 Dec. 1991 22 p
(Contract N00014-85-K-0474)
(AD-A244059; TR-22) Avail: NTIS HC/MF A03 CSCL 07/6

A series of 17 polymers was etched in RIE mode in oxygen alone and in a mixture of carbon tetrafluoride with oxygen (8 pct. O2). Rates were monitored using a laser interferometer. The etch rates in oxygen at 0.25 watt/sq cm fell in the range of 200 to 300 nm/min for the aromatics (polystyrene and derivatives), 350 to 450 nm/min for the aliphatics (methacrylates and vinyl acetate), and 500 to 850 nm/min for the cellulosics (methyl ether and nitrate). At a power density of 0.50 watt/sq cm the etch rates were about 75 to 80 pct. higher than those at the lower power density. The etch rate in the fluoride mixture was about half that in the oxygen, all other parameters being the same. Plasticizers

which lower the Tg of polymers based on vinyl chloride, methyl methacrylate, or styrene do not change the etch rate of the polymers very much. There is slight increase in the rate for polystyrene and a slight decrease in the rate for poly(methyl methacrylate). All the compositional effects on etching rate seem to be related to the mole fractions of carbon and oxygen in the resist. GRA

N92-19280# Texas Univ., Austin.
POLYMER-POLYMER INTERFACES IN BLENDS AND COMPOSITES Final Report, 15 Mar. 1988 - 14 Sep. 1991
D. R. Paul and J. W. Barlow 11 Nov. 1991 21 p
(Contract DAAL03-88-K-0004)
(AD-A244107; ARO-25229.35-CH) Avail: NTIS HC/MF A03 CSCL 11/10

The principal focus of this research has been on improving adhesion at the polymer-polymer interface in order to achieve useful polymer blends and certain composites. Adhesion measurements were made on several systems to demonstrate that favorable enthalpic interactions between the segments of a block copolymer and a homopolymer substrate can improve their adhesion and that appropriate chemical reactions at the polymer-polymer interface also promote adhesion. These principles were used for developing polymer blends that are tough. The matrix materials of the systems examined include polyamides, styrene/acrylonitrile copolymers, styrene/maleic anhydride copolymers, etc. Composites based on liquid crystalline polymers were examined briefly. Gas transport properties in selective systems are also included. A useful way for introducing chemical functionality for in-situ reactions at the polymer-polymer interface is to add a polymer having this functionality which is miscible with one of the components. Several examples of such miscible systems were discovered and are reported here. GRA

N92-19340# Oak Ridge National Lab., TN.
FIBERGLASS MATERIAL SPECIFICATION 2
B. J. Frame and C. J. Janke Oct. 1991 5 p
(Contract DE-AC05-84OR-21400)
(DE92-005405; ORNL/ATD-54/R1) Avail: NTIS HC/MF A01

This report describes the requirements for composite parts to be furnished to Martin Marietta Energy Systems, Inc. Topics discussed include: Part Fabrication Requirements, Scope, and Applicable Documents. DOE

N92-19342# Sandia National Labs., Albuquerque, NM.
THE USE OF ELECTROPHORETICALLY DEPOSITED DIAMOND POWDER COATINGS AS A PRECURSOR FOR CHEMICALLY VAPOR DEPOSITED DIAMOND
J. K. G. Panitz 1991 6 p Presented at the 8th Target Fabrication Specialists Meeting, Albuquerque, NM, 23-26 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE92-003957; SAND-91-1803C; CONF-9109319-1) Avail: NTIS HC/MF A02

It has generally been observed that in order to expedite the formation of chemical vapor deposited (CVD) diamond coatings, it is desirable to prepare a substrate by 'seeding' it with diamond powder. We have determined that thick, stress free, shaped, diamond powder coatings can be electrophoretically deposited in a relatively short amount of time. These diamond powder precursor coatings are then densified in a hot filament assisted CVD reactor to produce good quality CVD diamond/diamond powder composites. This combination of deposition techniques avoids many potential problems associated with predominantly CVD diamonds. DOE

N92-19414# Construcciones Aeronauticas S.A., Madrid (Spain). Div. de Proyectos.
CHEMICAL CHARACTERIZATION OF THE HEXEL F593/T-300 MATERIAL [CARACTERIZACION QUIMIORREOLOGICA DEL MATERIAL HEXCEL F593/T-300]
S. Lazcano 22 Feb. 1991 37 p In SPANISH
(INFORME-I-519/90; ETN-92-90816) Avail: NTIS HC/MF A03

A study aimed at establishing the kinetic and rheological parameters of the curing reaction of the Hexcel F593/T-300 resin, in unidirectional impregnation, is presented. Results for Differential Scanning Calorimetry (DSC) are given. In particular, the relation existing between the obtained data for different techniques in the gel point region is established. ESA

N92-19419# Ames Lab., IA.
SILYL-ACETYLENE POLYMERS FOR USE AS PRECURSORS TO SILICON CARBIDE FIBERS Ph.D. Thesis
M. K. Meyer 20 Dec. 1991 195 p
(Contract W-7405-eng-82)
(DE92-005097; IS-T-1601) Avail: NTIS HC/MF A09

The steps involved in production of silicon carbide fiber using silyl acetylene polymer precursors can be separated into four processing steps: polymer synthesis, fiber spinning, fiber crosslinking, and pyrolysis. Practical experimental considerations in each step are discussed. DOE

N92-19436# Sandia National Labs., Albuquerque, NM.
EVALUATION OF SURFACE ANALYSIS METHODS FOR CHARACTERIZATION OF TRACE METAL SURFACE CONTAMINANTS FOUND IN SILICON IC MANUFACTURING
Alain C. Diebold, P. Maillot, M. Gordon, J. Baylis, J. Chacon, R. Witowski, H. Arlinghaus (Atom Sciences, Inc., Oak Ridge, TN.), J. A. Knapp, and B. L. Doyle 1991 21 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-002359; SAND-91-1083C; CONF-911132-1) Avail: NTIS HC/MF A03

A major topic at recent silicon-based integrated circuit (IC) manufacturing symposia is the pursuit of decreased contamination levels. The aim is to remove contamination from both processes and materials. In conjunction with this effort, characterization methods are being pushed to lower and lower detection limits. In this paper, we evaluate surface analysis methods used to determine the concentration of inorganic contamination on unpatterned Si wafers. We compare sampling depths, detection limits, and applicability of each method for use in support of Si IC manufacturing. This comparison is further limited to Fe and Cu which are transition metal contaminants associated with manufacturing yield loss. The surface analysis methods included in this evaluation are: total reflection x-ray fluorescence (TXRF or TRXRF); secondary ion mass spectrometry (SIMS); two 'post-ionization' methods surface analysis by laser ionization (SALI) and sputter initiated resonant ionization spectroscopy (SIRIS); heavy ion backscattering spectroscopy (HIBS); and vapor phase phase decomposition (VPD) based methods atomic absorption (VPD-AA) along with VPD-TXRF. Sets of 6 in. Si wafers with concentration levels between 10 exp 9 atoms/cm exp 2 and 10 exp 12 atoms/cm exp 2 Fe and Cu were characterized by TXRF, SIMS, SIRIS, and HIBS. This data allows estimation of detection limits (DL's)and relative method accuracy. In Section 1, we describe each surface analysis method and the circumstance under which it would be used to support Si IC manufacturing. The equipment used for this comparison and the 150 mm Si wafer set are described in Section 2. Results from each method are contrasted in Section 3. Finally, a conclusion is presented in Section 4. DOE

N92-19450*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE EFFECT OF ION PLATED SILVER AND SLIDING FRICTION ON TENSILE STRESS-INDUCED CRACKING IN ALUMINUM OXIDE
Harold E. Sliney and Talivaldis Spalvins 1991 17 p Proposed for presentation at the Annual Meeting of the Society of Tribologists and Lubrication Engineers, Philadelphia, PA, 4-7 May 1992
(NASA-TM-105366; E-6651; NAS 1.15:105366) Avail: NTIS HC/MF A03 CSCL 11B

A Hertzian analysis of the effect of sliding friction on contact stresses in alumina is used to predict the critical load for crack generation. The results for uncoated alumina and alumina coated

with ion plated silver are compared. Friction coefficient inputs to the analysis are determined experimentally with a scratch test instrument employing an 0.2 mm radius diamond stylus. A series of scratches were made at constant load increments on coated and uncoated flat alumina surfaces. Critical loads for cracking are detected by microscopic examination of cross sections of scratches made at various loads and friction coefficients. Acoustic emission (AE) and friction trends were also evaluated as experimental techniques for determining critical loads for cracking. Analytical predictions correlate well with micrographic evidence and with the lowest load at which AE is detected in multiple scratch tests. Friction/load trends are not good indicators of early crack formation. Lubrication with silver films reduced friction and thereby increased the critical load for crack initiation in agreement with analytical predictions. Author

N92-19472# Sandia National Labs., Albuquerque, NM.
SELECTIVE DEPOSITION OF COPPER ON POLY(TETRAFLUOROETHYLENE)
R. R. Rye, K. M. Chi, M. Hampden-Smith, and T. T. Kodas (New Mexico Univ., Albuquerque.) 1991 5 p Presented at the Advanced Metallization for ULSI Applications Conference, Newark, NJ, 7-19 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-003949; SAND-91-2263C; CONF-9110301-1) Avail: NTIS HC/MF A01

An additive three step process has been developed for patterned deposition of Cu onto polytetrafluoroethylene (PTFE). The first step involves patterned irradiation with X-rays or electrons (this is thought to cross link the PTFE surface); step two involves chemical etching (with the result that only the non-irradiated areas are etched); and step three involves selective chemical vapor deposition (CVD) of Cu onto the etched surface at 200 C using hexafluoroacetylacetonato Cu(I) trimethylphosphine (hfac)Cu-(PMe3)). The non-irradiated areas of the surface are covered by a continuous, dense Cu film with X-ray photoelectron spectra shown to contain only surface impurities that are easily removed by a short Ar ion sputter. The irradiated areas show the presence of only C and F, characteristic of PTFE. DOE

N92-19480# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FAILURE CHARACTERIZATION OF A FIBER REINFORCED CERAMIC MATRIX COMPOSITE WITH CIRCULAR HOLES M.S. Thesis
Daniel E. Bullock Dec. 1991 122 p
(AD-A243867; AFIT/GAE/ENY/91D-20) Avail: NTIS HC/MF A06 CSCL 11/2

The purpose of this study was to investigate the performance of a fiber reinforced ceramic matrix composite with circular holes. The specific objectives were to (1) determine the relationship between tensile failure stress and the ratio of hole diameter to specimen width, and (2) to examine the initiation and progression of damage. The ceramic matrix composite used was SiC/1723, composed of continuous silicon titanium carbide fibers in an aluminosilicate glass ceramic matrix. Uniaxial tensile tests were performed at room temperature on two different layups; unidirectional (0)(sub 8) and (0/90)(sub 2S) symmetric. Each layup was tested at three diameter-to-width ratios. Damage data were gathered using acoustic emission, strain gauges, replication techniques, and ultrasound (C-scan). Specimens were also sectioned after damage and examined. Strain data from the region of the hole provided the best indication of initial damage in the (0)(sub 8) layup. Acoustic emission techniques accurately indicated the point of initial damage in the (0/90)(sub 2S) layup. The Whitney-Nuismer failure theory for notched composites was adapted to allow for specimens of varying widths, and was found to fit the experimental data well. GRA

N92-19498*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH MOLECULAR WEIGHT FIRST GENERATION PMR POLYIMIDES FOR 343 C APPLICATIONS
Diane C. Malarik and Raymond D. Vannucci Dec. 1991 17 p (NASA-TM-105364; E-6742; NAS 1.15:105364) Avail: NTIS HC/MF A03 CSCL 11B

The effect of molecular weight on 343 C thermo-oxidative stability (TOS), mechanical properties, and processability, of the first generation PMR polyimides was studied. Graphite fiber reinforced PMR-15, PMR-30, PMR-50, and PMR-75 composites (corresponding to formulated molecular weights of 1500, 3000, 5000, and 7500, respectively) were fabricated using a simulated autoclave process. The data reveals that while alternate autoclave cure schedules are required for the high molecular weight resins, low void laminates can be fabricated which have significantly improved TOS over PMR-15, with only a small sacrifice in mechanical properties. Author

N92-19522# Construcciones Aeronauticas S.A., Madrid (Spain). Div. de Proyectos.
CHEMICAL CHARACTERIZATION OF THE HERCULES 8552/AS4 MATERIAL [CARACTERIZACION QUIMIORREOLOGICA DEL MATERIAL HERCULES 8552/AS4]
S. Lazcano and A. T. Rodriguez 22 Feb. 1990 32 p In SPANISH
(INFORME-I-506/90; ETN-92-90818) Avail: NTIS HC/MF A03

A study aimed at establishing the kinetic and rheological parameters of the curing reaction of the Hercules 8552 resin and the influence of the fiber AS4 on these parameters in unidirectional preimpregnation is presented. Results showing DSC (Differential Scanning Calorimetry) curves are illustrated. A program for kinetic parameter adjustment of the curing process is listed. ESA

N92-19573# Allied-Signal Aerospace Co., Kansas City, MO.
FABRICATION OF POLYETHERETHERKETONE (PEEK) PARTS
R. W. Nelson Dec. 1991 43 p
(Contract DE-AC04-76DP-00613)
(DE92-004883; KCP-613-4473) Avail: NTIS HC/MF A03

A literature search was conducted for polyetheretherketone (PEEK) thermoplastic to investigate its physical properties and molding applications. Simple molds were designed, built, and tested using PEEK molding compound. Molding parameters and shrink factors were determined. Physical properties varied with the percent of crystalline PEEK present. Annealing the molded parts enhanced their physical properties and increased the percent crystallinity. DOE

N92-19590# Argonne National Lab., IL.
EQUILIBRIUM AND NON-EQUILIBRIUM METAL-CERAMIC INTERFACES
Y. Gao and K. L. Merkle 1991 7 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract W-31-109-eng-38)
(DE92-004975; ANL/CP-74998; CONF-911202-17) Avail: NTIS HC/MF A02

Metal-ceramic interfaces in thermodynamic equilibrium (Au/ZrO2) and non-equilibrium (Au/MgO) have been studied by TEM and HREM. In the Au/ZrO2 system, ZrO2 precipitates formed by internal oxidation of a 7 pct. Zr-Au alloy show a cubic ZrO2 phase. It appears that formation of the cubic ZrO2 is facilitated by alignment with the Au matrix. Most of the ZrO2 precipitates have a perfect cube-on-cube orientation relationship with the Au matrix. The large number of interfacial steps observed in a short time annealing experiment indicate that the precipitates are formed by the ledge growth mechanism. The lowest interfacial energy is indicated by the dominance of closed packed (111) Au/ZrO2 interfaces. In the Au/MgO system, composite films with small MgO smoke particles embedded in a Au matrix were prepared by a thin film technique. HREM observations show that most of the Au/MgO interfaces have a strong tendency to maintain a dense lattice structure across the interfaces irrespective of whether the interfaces are incoherent of semi-coherent. This indicates that there may be relatively strong bond between MgO and Au. DOE

N92-19631# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
INVESTIGATIONS OF THE ORIGINS OF METASTABLE LIGHT-INDUCED CHANGES IN HYDROGENATED AMORPHOUS SILICON
J. D. Cohen (Oregon Univ., Eugene.) Dec. 1991 36 p
(Contract DE-AC02-83CH-10093)
(DE92-001178; NREL/TP-214-4592) Avail: NTIS HC/MF A03

The work performed for this contract continued investigations of the origins of metastable effects in a-Si:H through three kinds of studies: (1) the effect of carbon impurities in a-Si:H samples at low concentrations using drive-level capacitance profiling measurements on samples whose carbon content was intentionally modulated spatially during growth; (2) the characterization of metastable states in n-type doped a Si:H samples caused by quench cooling and by light-soaking with partial annealing; and (3) the use of depletion-width-modulated ESR spectroscopy together with junction capacitance spectroscopy to investigate deep defect states for various metastable states of a 10- and an 80-Vppm PH3-doped a-Si:H sample. DOE

N92-19766# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. des Materiaux Macromoleculaires.
STUDY OF ASSOCIATION PHENOMENA CALLED INTO PLAY DURING THE FORMATION OF GELS OBTAINED DURING THE SYNTHESIS OF POLYURETHANE IN STYRENE SOLUTIONS Ph.D. Thesis [ETUDE DES PHENOMENES D'ASSOCIATION MIS EN JEU LORS DE LA FORMATION DE GELS PHYSIQUES OBTENUS PAR SYNTHESE DE POLYURETHANES EN SOLUTION DANS LE STYRENE]
Fu-Cai Wang 1991 209 p In FRENCH
(ISAL-91-0042; ETN-92-90858) Avail: NTIS HC/MF A10

The intra and intermolecular association mechanisms, and the formation of gels involved in the hardening of an unsaturated polyester resin are discussed. A reactive model of a saturated polyadipate oligomer reacting with diisocyanate in a styrene solution is used as the basis of the research. Physical gel phenomenon are observed for a wide range of concentration levels. Infrared Fourier transform analysis of the gels obtained, allows quantitative analysis of the hydrogen bonds in the polyurethane chains to be carried out. ESA

N92-19767# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. des Materiaux Macromoleculaires.
SYNTHESIS AND NETWORK PROPERTIES OF EPOXY AND ISOCYANATE Ph.D. Thesis [SYNTHESE ET PROPRIETES DE RESEAUX A BASE D'EPOXY ET D'ISOCYANATE]
Dominique Caille 1991 273 p In FRENCH
(ISAL-91-0060; ETN-92-90859) Avail: NTIS HC/MF A12

Epoxy and isocyanate base networks are studied. Two different types of material, one due to the addition of epoxy to isocyanate, the other due to the formation of an isocyanate trimer, are studied. The temperatures at which the different formation tractions take place are identified. The order of the reactions and their activation energies are identified and outlined. The viscoelastic properties of the networks are studied. The networks are shown to possess interesting mechanical characteristics which drop off rapidly when temperature and oxidation constraints overlap. ESA

N92-19782# Wyoming Univ., Laramie.
CLONING AND STRUCTURE OF DIFFERENT TYPES OF SPIDER SILK Final Report, period ending 1 Dec. 1990
Randolph V. Lewis 10 Nov. 1991 7 p
(Contract N00014-89-J-1564)
(AD-A242222) Avail: NTIS HC/MF A02 CSCL 11/7

Based on both physical and chemical properties it is clear that spider silks are very different than silk worm silk. In particular, the amino acid composition of the various spider silks are different with the variations being in Glx and Pro which are much higher than in worm silk. Studies by others using x-ray diffraction and by us with FTIR demonstrate that the dragline silk is predominantly Beta sheet. In the past contract period we constructed a cDNA library in a plasmid vector from the silk glands (dragline) of one species of spider. We isolated several clones which are positive in hybridizing to our DNA probes based on the protein sequence. We sequenced two clones which encoded different proteins both of which are components of major ampullate silk. We have obtained clones which appear to encode proteins for other spider silks as well. GRA

N92-19809# Massachusetts Univ., Amherst. Dept. of Chemistry.
THEORETICAL INVESTIGATIONS AND ATTEMPTED SYNTHESIS OF ORGANIC MAGNETIC POLYMERS AND OLIGOMERS Final Report, 1 Jun. 1987 - 31 Mar. 1991
Paul M. Lahti 11 Dec. 1991 5 p
(Contract N00014-87-K-0464)
(AD-A244030) Avail: NTIS HC/MF A01 CSCL 09/1

A final summary is given concerning the present state of attempts to generate very high spin organic molecules and polymers which possess ferromagnetic bulk properties. Methodology has been developed to predict the types of structures most likely to have such properties, and significant progress has been made toward photochemical generation of polyradicals in the solid state. This project was aimed at designing magnetic properties in new materials, particularly organic polyradicals. We desired to use semiempirical molecular orbital plus configuration interaction computational methods to predict what types of structural features are most important in maximizing desirable ferromagnetic exchange interactions within organic systems (intramolecular exchange). Once appropriate structural models were delineated by theory, we also aimed to develop a solid state photochemical method to generate phenoxyl radical sites in a polymeric material. Use of a solid-state polyradical synthesis method would allow masking techniques for production of magnetic sites on a surface, and would minimize the kinds of radical quenching reactions that tend to reduce stability of radicals under free diffusion (solution) conditions. GRA

N92-19824# Pennsylvania State Univ., University Park. Center for Advanced Materials.
INFILTRATION OF GREEN OR PARTIALLY SINTERED CERAMICS. VOLUME 1: ALUMINA-ZIRCONIA COMPOSITES. VOLUME 2: MULLITE-ALUMINA PARTICULATE COMPOSITES Final Report, 1 Jun. 1986 - Aug. 1990 Ph.D. Thesis
Dec. 1990 509 p
(Contract GRI-5084-238-1302)
(PB91-240606; CAM-9006; GRI-90/0240) Avail: NTIS HC/MF A22 CSCL 11C

The infiltration process developed in the project is a novel method for combining two or more components to produce a ceramic composite material with mechanical properties superior to those of its individual phases. The processing approach can be used either to improve the surface of a material or to create a material in which the composite properties are varied throughout the component. The technique consists of introducing a liquid into a porous body and heating the composite material to produce decomposition, and in some cases, a solid state reaction of the infiltered phase. A patent application for the infiltration process has been filed and the methodology has been made available for licensing. Author

N92-19838# Ames Lab., IA.
EXPLORING NOVEL SILICON-CONTAINING POLYMERS: FROM PRECERAMIC POLYMERS TO CONDUCTING POLYMERS WITH NONLINEAR OPTICAL PROPERTIES Ph.D. Thesis
Yi Pang Oct. 1991 240 p
(Contract W-7405-eng-82)
(DE92-001691; IS-T-1507) Avail: NTIS HC/MF A11

Several new types of silicon-containing preceramic polymers, such as poly(diorganosilacetylene) and poly(diorganosilvinylene), have been synthesized with molecular weights from 10,000 to 120,000. These polymers can be thermally converted to SiC with moderate to high char yields. Ready solubility and good processability made these types of polymers attractive in their

applications to ceramics. The thermal polymerization of diethynyldiphenyl-silane, which was reported in 1968 to afford poly(diphenylsilyldiacetylene) via dehydrogenation, was reinvestigated. Spectroscopic studies showed that the polymer had a structure of polyacetylene type not diacetylene. Diphenyldiethynylgermane and a series of diorganodiethynylsilances were synthesized. These could be polymerized in the presence of MoCl5 or WCl6 to afford a soluble, violet material with Mw as high as 108,000. DOE

N92-19858# Pacific Northwest Lab., Richland, WA.
THERMAL SHOCK OF CERAMIC MATERIALS
L. R. Bunnell Nov. 1991 8 p Presented at the National Educators Workshop, Oak Ridge, TN, 12-14 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006472; PNL-SA-20165; CONF-9111111-6) Avail: NTIS HC/MF A02

This report discusses a demonstration which is suitable for students in materials science at the high school or college levels. The demonstrations present the concept of thermal shock in ceramic materials and illustrate the pertinent factors of materials selection. DOE

N92-19874# Particle Technology, Inc., College Park, MD.
DEVICE FOR SORTING MICRON SIZE DIELECTRIC AND CONDUCTING POWDERS Final Report, Aug. 1990 - Feb. 1991
Madhau B. Ranade, Ruijng Han, and James W. Gentry Aug. 1991 73 p
(Contract DAAA15-90-C-1065)
(AD-A242349; CRDEC-CR-113) Avail: NTIS HC/MF A04 CSCL 14/2

A laboratory classifier was designed and fabricated to classify several test powders in the micron and submicron size range. These powders represent both conducting and dielectric media. The classifier is based on inertial and electrical separation and sorting of particles according to the particle size. Test particles of known size characteristics were used to determine the performance of the devices. Particles in the micron and submicron size range are used for various applications such as obscuration smokes, coatings, ceramic, and composite materials. It is often desirable to use particles of specific size and shape to maximize the performance potential of smokes or other materials. A device to sort (or to classify) particles in these micron and smaller size ranges would represent a reasonable solution since inexpensive, commonly available materials such as pigments and other powders containing a broader size distribution may be used as the starter material. GRA

N92-19898# Oak Ridge National Lab., TN.
THE BEHAVIOR OF INTERSTITIALS IN IRRADIATED GRAPHITE
D. F. Pedraza 1991 7 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005167; CONF-911202-22) Avail: NTIS HC/MF A02

A computer model is developed to simulate the behavior of self-interstitials with particular attention to clustering. Owing to the layer structure of graphite, atomistic simulations can be performed using a large parallelepipedic supercell containing a few layers. In particular, interstitial clustering is studied here using a supercell that contains two basal planes only. Frenkel pairs are randomly produced. Interstitials are placed at sites between the crystal planes while vacancies are distributed in the two crystal planes. The size of the computational cell is 20000 atoms and periodic boundary conditions are used in two dimensions. Vacancies are assumed immobile whereas interstitials are given a certain mobility. Two point defect sinks are considered, direct recombination of Frenkel pairs and interstitial clusters. The clusters are assumed to be mobile up to a certain size where they are presumed to become loop nuclei. Clusters can shrink by emission of singly bonded interstitials or by recombination of a peripheral interstitial with a neighboring vacancy. The conditions under which interstitial clustering occurs are reported. It is shown that when clustering occurs the cluster size population gradually shifts towards the largest size cluster. The implications of the present results for irradiation growth and irradiation-induced amorphization are discussed. DOE

N92-19964# National Inst. of Standards and Technology, Gaithersburg, MD.
POLYMERS: TECHNICAL ACTIVITIES, 1991
L. E. Smith and B. M. Fanconi Oct. 1991 131 p Presented at the NAS-NRC Assessment Panel, 13-14 Feb. 1992
(PB92-116284; NISTIR-4696) Avail: NTIS HC/MF A07 CSCL 07B

All of the Polymer Divisions programs are described and are organized in six categories: (1) specialty polymers; (2) chemical properties; (3) mechanical performance; (4) polymer composites; (5) polymer blends and solutions; and (6) dental and medical materials. GRA

N92-19984# Wisconsin Univ., Milwaukee. Dept. of Chemistry.
ALUMINUM COORDINATION AND ACTIVE SITES ON ALUMINAS, Y ZEOLITES, AND PILLARED LAYERED SILICATES
J. J. Fripiat 1991 6 p
(Contract DE-FG02-90ER-14130)
(DE92-006746; DOE/ER-14130/1) Avail: NTIS HC/MF A02

This report covers the activity of the laboratory over 15 months, from June 1, 1990 until August 31, 1991. Our work has been deployed in four directions, namely: (1) Study of the distribution of aluminum within three possible kinds of coordination shells: four-fold, five-fold, and six-fold, in aluminas and dealuminated zeolites by high-resolution solid state NMR or MAS NMR. Besides the classical one pulse spectra, nutation spectra have been studied. (2) Study of the electron deficient sites by electron paramagnetic resonance (EPR) of probe molecules on aluminas and decationated zeolites. Electron deficient sites are considered as Lewis sites. (3) Study of the model isomerization reaction 1 butene (yields) 2 cis or trans butene on the aluminas characterized in (1) and (2). (4) Synthesis of a silicate lattice in which silicon has been partially replaced by aluminum. The chosen silicate is that of zeolitic (fibrous) sepiolite. DOE

N92-20003# Oak Ridge National Lab., TN.
MICROSTRUCTURAL TAILORING OF TRANSFORMATION TOUGHENED CERAMICS
P. F. Becher, K. B. Alexander, A. Bleier, C. G. Westmoreland, W. H. Warwick, and S. B. Waters 1991 15 p Presented at the 4th Symposium on Advanced Ceramics, Kawasaki (Japan), 24-25 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005433; CONF-9110319-1) Avail: NTIS HC/MF A03

The tetragonal-to-monoclinic transformation temperature M(sub s) and the transformation toughening contribution (Delta)K(sup T) increase with an increase in the grain size of the tetragonal zirconia present in either polycrystalline tetragonal zirconia or zirconia-toughened alumina composites. However, the grain size dependence of both M(sub s) and (Delta)K(sup T) increases with a decrease in zirconia content. Thus, the microstructures of such materials are carefully tailored to optimize their performance. This has been achieved here by employing colloidal processing conditions which promote weak particle-particle interactions in the binary suspension to obtain uniform spatial distribution of both the zirconia and alumina phases and to maintain the initial narrow size distributions by minimizing agglomeration and differential settling. Sintering conditions were then utilized to obtain dense materials of selected grain sizes. However, the grain growth rates are influenced by the degree of interconnectivity of the phases. For example, decreasing the zirconia content results in reducing the zirconia grain rates. Theoretical analysis reveals that the main factor in the grain size dependency of the transformation behavior is the increasing contribution of internal residual tensile stresses, generated by thermal expansion anisotropy/mismatch, with increase in grain size. The observed increase in the dependence

of M(sub s) on grain size for Al2O3-ZrO2 (12 mol percent CeO2) composites with increasing alumina content vs. that for ZrO2 (12 mol percent CeO2) ceramics confirm the role of the internal residual stress contribution in promoting the transformations. The control of the M(sub s) temperature by regulating the zirconia grain size then allows the fracture toughness of each the composites to be optimized. DOE

N92-20019# Swedish Inst. for Materials Testing, Boras.
FRACTOGRAPHIC STUDIES OF CYCLICALLY DEFORMED CERAMICS
L. Carlsson 1991 29 p
(PB92-115617; SP-RAPP-1991:10; ISBN-91-7848-265-8) Avail: NTIS HC/MF A03 CSCL 11C

Comparatively little is known about cyclic fatigue processes in ceramics. Fractographic studies were performed on the fracture surfaces of silicon nitride and yttria tetragonal zirconia polycrystals, which had been cyclically loaded to failure. The micrographs showed numerous small microcracks in the fatigued region in the vicinity of the origin of failure. The role of cyclic stress is supposed to be basically a grain boundary effect. In addition, a hypothetical model proposed by Horibe, based on asperity contacts, was confirmed. Author

N92-20034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THERMAL CONDUCTANCE OF TWO INTERFACE MATERIALS AND THEIR APPLICATIONS IN SPACE SYSTEMS
J. J. Scialdone, C. H. Clatterbuck, and J. L. Wall Mar. 1992 11 p
(NASA-TM-104554; Rept-92B00012; NAS 1.15:104554) Avail: NTIS HC/MF A03 CSCL 11C

The temperature control of spacecraft and instrument systems and subsystems requires heat transfer interface materials that possess good thermal and structural characteristics, among other properties, to respond to the vacuum environment of space. These materials must be easy to apply to, and remove from, the surfaces where they are applied, and must be able to withstand power dissipation extremes, and be used for different clamping configurations and pressures. Silicone based greases, used in the past, tend to migrate and to contaminate nearby surfaces. Bare metal to metal contact offers low thermal conductance and difficulties in estimating the actual heat transfer. Several polymeric materials containing different thermal conductive compounds and structural reinforcements were prepared to overcome grease and metal problems. Two polymeric materials were evaluated: Cho-Therm 1671 elastomer; and the CV-2946, a conductive RTV silicone. Tests were done to learn more about these products. Results indicate that the tightly bolted, torqued fixtures did not buckle or distort, and provided optimum thermal conductance. Fixtures simulating actual spacecraft configuration suffered bowing and separating. Author

N92-20035*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POLYIMIDES WITH PENDENT ETHYNYL GROUPS
Brian J. Jensen, Paul M. Hergenrother, and Godson Nwokogu (Hampton Univ., VA.) Jan. 1992 14 p
(NASA-TM-104198; NAS 1.15:104198) Avail: NTIS HC/MF A03 CSCL 11C

Several new polyimides containing pendent ethynyl groups were prepared and characterized. The new polyimides were prepared from the following novel ethynyl containing diamines; 1,1-bis(p aminophenyl)-1-(p ethynylphenyl) 2,2,2-trifluoroethane, and 1, 1-bis(p aminophenyl)-1-(p phenylethynylphenyl)-2,2,2 trifluoroethane, and 1, 1-bis(p aminophenyl)-1-(p hexynylphenyl)-2,2,2 trifluoroethane by reacting with either 3,3',4,4' benzophenone tetracarboxylic dianhydride or 2,2-bis(3,4 dicarboxyphenyl) hexafluoropropane dianhydride (6FDA). Inherent viscosities for the polymers ranged from 0.26 to 0.94 dL/g. Three copolymers prepared by reacting 10 mole pct. of one of the ethynyl containing diamines and 90 mole pct. of 2,2-bis-(4-(4 aminophenoxy)phenyl) hexafluoropropane with 6FDA were also prepared and characterized. Inherent viscosities for these copolymers ranged from 1.08 to 1.54 dL/g. Original polyimide glass transition temperatures were approx. 265 C while curing at 300 to 350 C for 1 hr in air increased the Tgs by approx. 10 C. Film properties and thermal stability were also measured for these copolyimides. Author

N92-19316*# Christian Brothers Coll., Memphis, TN. Dept. of Chemical Engineering.
EVALUATION OF SURLYN 8920 AS PHE VISOR MATERIAL AND EVALUATIONS OF NEW ADHESIVES FOR IMPROVING BONDING BETWEEN TEFLON AND STAINLESS STEEL AT CRYOGENIC TEMPERATURE
Asit K. Ray *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 318-343 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 11B

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-19111 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
THE FORMAL SPECIFICATION OF SAFETY REQUIREMENTS FOR THE STORAGE OF EXPLOSIVES
Paul Mukherjee and Victoria Stavridou (Royal Holloway and Bedford New Coll., Egham, England) Aug. 1991 69 p Sponsored by Dept. of Trade and Industry
(NPL-DITC-185/91; ISSN-0262-5369; ETN-92-91042) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

A set of requirements for the storage of explosive articles and substances is based on practices recommended by the United Nations for the transport of such items. The precise formulation of these storage requirements is considered using the formal specification language VDM. Some properties of these safety requirements are proved and the specification is translated into the executable specification language OBJ3. ESA

N92-19275# Air Products and Chemicals, Inc., Allentown, PA.
LIQUID PHASE METHANOL LAPORTE PROCESS DEVELOPMENT UNIT: MODIFICATION, OPERATION, AND SUPPORT STUDIES
11 Mar. 1991 54 p Prepared in cooperation with Chem Systems, Inc., Tarrytown, NY
(Contract DE-AC22-87PC-90005)
(DE92-002585; DOE/PC-90005/T54) Avail: NTIS HC/MF A04

The objectives of the present work can be divided into three parts. The first objective was to develop a best-fit model for the older methanol synthesis catalyst (BASF S3-85) data base. At the time that this work commenced (June 1989), the BASF S3-85 data base contained many rate measurements accumulated over a few years. The newer catalyst (BASF S3-86) data base, at that time, contained only a few observations and did not include a broad range of conditions. Thus, a second objective of this work was to expand the BASF S3-86 data base to include more rate observations over a broader range of conditions. Finally, after expansion of the BASF S3-86 data base, the third objective was to develop a rate expression to describe this data base. This would include the application of rate expressions developed for the BASF S3-85 catalyst, as well as new models. DOE

N92-19405# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
WASTEPAPER AS A FEEDSTOCK FOR ETHANOL PRODUCTION
P. W. Bergeron and C. J. Riley Nov. 1991 23 p

(Contract DE-AC02-83CH-10093)
(DE92-001174; NREL/TP-232-4237) Avail: NTIS HC/MF A03

The possibility of using wastepaper as a cheap feedstock for production of ethanol is discussed. As the single largest material category in the municipal solid waste (MSW) stream, wastepaper is the main target of efforts to reduce the volume of MSW. And in the process for producing ethanol from lignocellulosics, the feedstock represents the highest cost. If wastepaper could be obtained cheaply in large enough quantities and if conversion process cost and efficiency prove to be similar to those for wood, the cost of ethanol could be significantly reduced. At the same time, the volume of wastepaper that must be disposed of in landfills could be lessened. DOE

N92-19712# Air Products and Chemicals, Inc., Allentown, PA.
LIQUID PHASE METHANOL LAPORTE PROCESS DEVELOPMENT UNIT: MODIFICATION, OPERATION, AND SUPPORT STUDIES
2 Feb. 1991 85 p Prepared in cooperation with Chem Systems, Inc., Tarrytown, NY
(Contract DE-AC22-87PC-90005)
(DE92-000279; DOE/PC-90005/T53) Avail: NTIS HC/MF A05

The primary focus of this Process Development Unit operating program was to prepare for a confident move to the next scale of operation with a simplified and optimized process. The main purpose of these runs was the evaluation of the alternate commercial catalyst (F21/0E75-43) that had been identified in the laboratory under a different subtask of the program. If the catalyst proved superior to the previous catalyst, then the evaluation run would be continued into a 120-day life run. Also, minor changes were made to the Process Development Unit system to improve operations and reliability. The damaged reactor demister from a previous run was replaced, and a new demister was installed in the intermediate V/L separator. The internal heat exchanger was equipped with an expansion loop to relieve thermal stresses so operation at higher catalyst loadings and gas velocities would be possible. These aggressive conditions are important for improving process economics. DOE

N92-19713# Air Products and Chemicals, Inc., Allentown, PA.
LIQUID PHASE METHANOL LAPORTE PROCESS DEVELOPMENT UNIT: MODIFICATION, OPERATION, AND SUPPORT STUDIES
2 Feb. 1991 445 p Prepared in cooperation with Chem Systems, Inc., Tarrytown, NY
(Contract DE-AC22-87PC-90005)
(DE92-000280; DOE/PC-90005/T51) Avail: NTIS HC/MF A19

This report consists of Detailed Data Acquisition Sheets for Runs E-6 and E-7 for Task 2.2 of the Modification, Operation, and Support Studies of the Liquid Phase Methanol Laporte Process Development Unit. (Task 2.2: Alternate Catalyst Run E-6 and Catalyst Activity Maintenance Run E-7). DOE

N92-19837*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPILATION OF LUNAR AND MARS EXPLORATION STRATEGIES UTILIZING INDIGENOUS PROPELLANTS
Diane L. Linne and Michael L. Meyer Jan. 1992 23 p
(NASA-TM-105262; E-6790; NAS 1.15:105262) Avail: NTIS HC/MF A03 CSCL 21I

The use of propellants manufactured from indigenous space materials has the potential to significantly reduce the amount of mass required to be launched from the Earth's surface. The extent of the leverage, however, along with the cost for developing the infrastructure necessary to support such a process, is unclear. Many mission analyses have been performed that have attempted to quantify the potential benefits of in situ propellant utilization. Because the planning of future space missions includes many unknowns, the presentation of any single study on the use of in situ propellants is often met with critics' claims of the inaccuracy of assumptions or omission of infrastructure requirements. The results of many such mission analyses are presented in one format. Each summarized mission analysis used different assumptions and baseline mission scenarios. The conclusion from the studies is that the use of in situ produced propellants will provide significant reductions in Earth launch requirements. This result is consistent among all of the analyses regardless of the assumptions used to obtain the quantitative results. The determination of the best propellant combination and the amount of savings will become clearer and more apparent as the technology work progresses. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N92-19413# European Space Agency, Paris (France).
PROMOTION OF INDUSTRIAL DEVELOPMENT AND UTILISATION OF MICROGRAVITY IN SPACE: THE RADIUS REPORT
T.-D. Guyenne, ed. Jun. 1991 31 p Original contains color illustrations
(ESA-BR-76; ISBN-92-9092-083-1; ETN-92-90750) Copyright Avail: NTIS HC/MF A03

In the Fall of 1990, the space commercialization office of ESA convened a task force of experts to examine the barriers which keep European industry from participating more actively in microgravity research efforts and to suggest ways to overcome these barriers. The experts were asked, in particular, to make suggestions for a business oriented strategy adapted to the particular requirements of the industrialists, and to make recommendations on ways to create the necessary synergies between industry and the research groups involved in microgravity research. The task force included representatives from space industry and space commercialization companies, in space user industry, and universities and research centers. The present report, based on the contributions of the members and the minutes of the meetings, summarizes the conclusions of the task force. The present participation of industry in microgravity research is described and a marketing approach to microgravity, designed to remove the different barriers that keep industry from being more active in this field is proposed. Specific problems of the microgravity research teams in universities and public research centers are addressed and it is shown that the present organization of microgravity research does not guarantee the best possible scientific results. The programs that have been set up by the U.S. and Japan to promote the participation of their industries in space programs are described. One possible way of encouraging the development of high level industrial microgravity research, through the creation of Research Associations for the Development of Industrial Utilisation of Space (RADIUS) is described. ESA

N92-19501*# National Aeronautics and Space Administration, Washington, DC.
MICROGRAVITY SCIENCE AND APPLICATIONS BIBLIOGRAPHY, 1991 REVISION
Feb. 1992 70 p
(NASA-TM-4348; NAS 1.15:4348) Avail: NTIS HC/MF A04 CSCL 22A

This edition of the Microgravity Science and Applications (MSA) Bibliography is a compilation of government reports, contractor reports, conference proceedings, and journal articles dealing with flight experiments using a low gravity environment to elucidate and control various processes, or with ground based activities that provide supporting research. It encompasses literature published but not cited in the 1990 Revision and that literature which has been published in the past year. Subdivisions of the bibliography include: Electronic materials; Metals, alloys, and composites; Fluids, interfaces and transport; Glasses and ceramics; Biotechnology; Combustion science; and Experimental technology, instrumentation, and facilities. Also included are a limited number of publications from the European, Soviet, and Japanese programs. Author

N92-19721*# Auburn Univ., AL. Dept. of Mechanical Engineering.
CHEMICAL COMPATIBILITY OF CARTRIDGE MATERIALS Progress Report, 1 Oct. 1990 - 1 Nov. 1991
Roy C. Wilcox and R. H. Zee 15 Nov. 1991 85 p
(Grant NAG8-846)
(NASA-CR-189478; NAS 1.26:189478) Avail: NTIS HC/MF A05 CSCL 22A

This twelve month progress report deals with the chemical compatibility of semiconductor crystals grown in zero gravity. Specifically, it studies the chemical compatibility between TZM, a molybdenum alloy containing titanium and zirconium, and WC 103, a titanium alloy containing Niobium and Hafnium, and Gallium arsenide (GaAs) and Cadmium Zinc Tellurite (CdZnTe). Due to the health hazards involved, three approaches were used to study the chemical compatibility between the semiconductor and cartridge materials: reaction retort, thermogravimetric analysis, and bulk cylindrical cartridge containers. A scanning electron microscope with an energy dispersive X-ray analyzer was used to examine all samples after testing. The first conclusion drawn is that reaction rates with TZM were not nearly as great as they were with WC 103. Second, the total reaction between GaAs and WC 103 was almost twice that with TZM. Therefore, even though WC 103 is easier to fabricate, at least half of the cartridge thickness will be degraded if contact is made with one of the semiconductor materials leading to a loss of strength properties. H.A.

N92-19778*# National Aeronautics and Space Administration, Washington, DC.
MICROGRAVITY SCIENCE AND APPLICATIONS PROGRAM TASKS, 1991 REVISION
Feb. 1992 288 p
(NASA-TM-4349; NAS 1.15:4349) Avail: NTIS HC/MF A13 CSCL 22A

Presented here is a compilation of the active research tasks for FY 1991 sponsored by the Microgravity Science and Applications Division of the NASA Office of Space Science and Applications. The purpose is to provide an overview of the program scope for managers and scientists in industry, university, and government communities. Included is an introductory description of the program, the strategy and overall goal, identification of the organizational structures and the people involved, and a description of each. The tasks are grouped into several categories: electronic materials; solidification of metals, alloys, and composites; fluids, interfaces, and transport; biotechnology; combustion science; glasses and ceramics; experimental technology, instrumentation, and facilities; and Physical and Chemistry Experiments (PACE). The tasks cover both the ground based and flight programs.
Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-19167*# Mississippi Univ., University. School of Engineering.
PULTRUSION PROCESS CHARACTERIZATION Final Report, 7 Aug. 1990 - 6 Aug. 1991
James G. Vaughan and Robert M. Hackett 25 Sep. 1991 127 p
(Contract NAS8-37193)
(NASA-CR-184275; NAS 1.26:184275) Avail: NTIS HC/MF A07 CSCL 13H

Pultrusion is a process through which high-modulus, lightweight composite structural members such as beams, truss components, stiffeners, etc., are manufactured. The pultrusion process, though a well-developed processing art, lacks a fundamental scientific understanding. The objective here was to determine, both experimentally and analytically, the process parameters most important in characterizing and optimizing the pultrusion of uniaxial fibers. The effects of process parameter interactions were experimentally examined as a function of the pultruded product properties. A numerical description based on these experimental results was developed. An analytical model of the pultrusion process was also developed. The objective of the modeling effort was the formulation of a two-dimensional heat transfer model and development of solutions for the governing differential equations using the finite element method. Author

N92-19229# Technische Univ., Eindhoven (Netherlands).
ASPECTS OF PRECISION GRINDING (PART ROUGHNESS, FORM ACCURATELY, AND A BASIC STUDY OF THE BRITTLE TO DUCTILE REMOVAL TRANSITION) Ph.D. Thesis
Jelm Franse 1991 167 p
(ETN-92-90894) Avail: NTIS HC/MF A08

Precision contour grinding as a method to produce complex shapes in steel, ceramics, and glass with submicron form accuracy and with roughness in the nanometer range is introduced. The machine and process aspects relevant for surface quality are discussed and an overview of the equipment used for the grinding experiments is given. Theoretical and experimental work regarding the influence of the process variables in the surface roughness profiles measured and roughness patterns observed on ground parts is emphasized. A good correlation exists between the theoretical predictions and the experimental findings, and a technique to avoid roughness patterns on ground surfaces is presented. A fundamental investigation of the conditions that determine the transition from ductile deformation to cracking is presented. Simulations are compared with the results of indentation experiments on glass. A fracture mechanics approach in conjunction with finite element calculations is shown to predict the threshold load for indentation cracking with reasonable accuracy. The influence of the dominant machine properties and process variables upon the form accuracy of ground parts is discussed. A model is used to study the influence of various parameters. The simulations are compared with experimental results. ESA

N92-19521# Norwegian Space Center, Oslo.
SPACE TECHNOLOGY AND INDUSTRIES IN NORWAY Annual Report, 1991
A.-L. Ruud Holtet, ed. Jun. 1991 59 p
(NSC-Rept(91)-8; ISBN-82-7542-009-1; ETN-92-90809) Avail: NTIS HC/MF A04

A short presentation of Norwegian Space Industry, the Norwegian Space Center, and some general information on space activities in Norway is given. The aim is to outline the industrial competence in Norway related to space and the experience and references of different firms. Industries active in space-related work are presented as well as research centers and institutes with strong industrial connection. ESA

N92-19544# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
TURBULENT UPWARD FLAME SPREAD FOR BURNING VERTICAL WALLS MADE OF FINITE THICKNESS Annual Report, 15 Aug. 1989 - 14 Aug. 1990
A. K. Kulkarni, C. I. Kim, and C. H. Kuo Sep. 1991 88 p
(Grant NANB-8D0849)
(PB92-112531; NIST/GCR-91/597) Avail: NTIS HC/MF A05 CSCL 13B

Presented here are the basic mechanisms of upward flame spread. A complete procedure to predict the flame spread on practical wall materials of finite thickness is developed, accompanied by appropriately verified experiments. Several wall materials were tested in the upward flame spread apparatus. Mathematical model development for predicting the upward flame spread was completed, and comparisons of data and predictions were made, in addition to the completion of many other supporting tasks. Author

N92-19572# Oak Ridge National Lab., TN.
OVERVIEW OF CFC REPLACEMENT ISSUES FOR HOUSEHOLD REFRIGERATION

E. A. Vineyard, L. Roke, and F. Hallett 1991 7 p Presented at the International Chlorofluorocarbon (CFC) and Halon Alternatives Conference, Baltimore, MD, 3-5 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004477; CONF-911256-4) Avail: NTIS HC/MF A02

In 1974, the famous ozone depletion theory of Rowland and Molina claimed that chlorofluorocarbons (CFCs) diffuse into the stratosphere where they are broken down by photolysis to release chlorine atoms that catalytically destroy ozone. Although the understanding of the science is still imperfect, there is little doubt that CFCs play a major role in the Antarctic ozone hole phenomenon and the decline in ozone observed in the rest of the world. Another issue that has become increasingly important is the potential of CFCs to change the earth's temperature and to modify the climate. While the main impact in global warming is made by increased concentrations of carbon dioxide, CFCs and other trace gases also contribute to this effect. In an effort to respond to the global environmental threat, a CFC protocol was adopted during a diplomatic conference in Montreal. This document, known as the Montreal Protocol, was ratified in 1988 and put into effect on January 1, 1989. In accordance with Article 6 of the Montreal Protocol, the countries that signed the agreement shall periodically assess the control measures provided for in the Protocol. As part of that assessment process, household refrigeration was investigated to determine the status of CFC-12 replacements. The conclusion was that much progress has been made towards finding a suitable replacement. Compressors designed for HFC-134a have efficiencies comparable to those for CFC-12 and acceptable reliability tests have been obtained with ester lubricants. In addition, other replacements such as R-152a and refrigerant mixtures exist, but will require more study. Cycle options, such as the Stirling cycle, may be viable, but are further out in the future. The impact of new refrigerants is expected to result in elimination of CFC-12 consumption in developed countries by 1997 and in developing countries by 2005. DOE

N92-19587# Energetics, Inc., Columbia, MD.
REFRIGERATION SYSTEMS PROGRAM SUMMARY
Dec. 1991 20 p
(Contract DE-AC02-83CH-10093)
(DE91-015024; DOE/CH-10093/120) Avail: NTIS HC/MF A03

In addition to saving energy, deploying advanced refrigeration technologies can substantially benefit the environment. Chlorofluorocarbons (CFCs) have been identified as a major cause of potential global climate change and about 20 pct. of the CFCs consumed by the U.S. are due to refrigeration systems. As the international Montreal Protocol will phase out CFC compounds no later than 2000, there is tremendous need to develop safe non-CFC refrigerants and working fluids, alternative refrigeration cycles, and non-CFC insulations for appliances. The U.S. Department of Energy (DOE) established the Refrigeration System Program in 1977 to lead a national effort to accelerate the deployment of cost effective and energy efficient air conditioning and refrigeration technologies. The program primarily conducts research and development on advanced refrigeration technologies. The program, managed by the Office of Building Technologies, which reports to DOE's Assistant Secretary for Conversation and Renewable Energy, encompasses several key activities such as investigating alternative refrigerants and refrigeration cycles, developing advanced technologies for future air conditioning and refrigeration equipment designs, and developing advanced appliance insulations. DOE

N92-19710# Army Missile Command, Redstone Arsenal, AL. Advanced Sensors Directorate.
DEVELOPMENT OF A TWO-STAGE ALTERNATE JOULE-THOMSON CRYO-COOLER FOR AAWS-M RISK REDUCTION Final Technical Report, Jan. 1990 - Apr. 1991
Alan W. Pope and Walter E. Miller Nov. 1991 22 p
(AD-A243957; AD-E951720; AMSMI-TR-RD-AS-91-22) Avail: NTIS HC/MF A03 CSCL 19/7

The latest in infrared imaging Focal Plane Array (FPA) technology incorporates Mercury Cadmium Telluride, a material that must be cooled to liquid nitrogen temperatures for operation. Fast cool-down, within five seconds, has been achieved under a harsh temperature environment (71 C). A Joule-Thomson Cryo-cooler employing two heat exchanger stages has been developed. High pressure krypton flows through one stage, providing initial pre-cooling, while high pressure nitrogen simultaneously flows through the other stage. The two-stage gas flow approach along with the superior pre-cooling properties of Krypton enable cool-down times of under five seconds. GRA

N92-19879# Oak Ridge National Lab., TN.
VALIDATION OF A PC BASED PROGRAM FOR SINGLE STAGE ABSORPTION HEAT PUMP
A. Zaltash and M. R. Ally Sep. 1991 79 p
(Contract DE-AC05-84OR-21400)
(DE92-004904; ORNL/TM-11923) Avail: NTIS HC/MF A05

An interactive computer code was developed to evaluate single stage absorption heat pump performance for temperature amplifier and heat amplifier modes using water as the refrigerant. This program performs the cycle calculations for single stage cycles based on the polynomial expressions developed to correlate experimental vapor-liquid-equilibrium (VLE) and specific enthalpy-concentration data for LiBr/water and (Li, K, Na)NO3 water systems as well as the properties of pure water. The operating parameters obtained by this program were tested against mass and energy balances in documented cases and the results show that the maximum deviation between coefficient of performance (COP) values obtained by this software and the ones previously calculated is less than 3 percent. In addition, this program was used to study the effect of solution temperature leaving the absorber on the other operating parameters. This type of analysis could be used to improve and optimize cycle design. DOE

N92-19946# National Inst. of Standards and Technology, Gaithersburg, MD. Building and Fire Research Lab.
NAVY SAFETY CENTER DATA ON THE EFFECTS OF FIRE PROTECTION SYSTEMS ON ELECTRICAL EQUIPMENT Final Report
Robert S. Levine Apr. 1991 86 p Sponsored by Nuclear Regulatory Commission
(PB92-108935; NISTIR-4620) Avail: NTIS HC/MF A05 CSCL 13B

Records of the Navy Safety Center, Norfolk, VA were reviewed to find data relevant to inadvertant operation of installed fire extinguishing systems in civilian nuclear power plants. Navy data show the incidence of collateral fire or other damage by fresh water on operating electrical equipment in submarines and in shore facilities is about the same as the civilian experience, about 30 percent. Aboard surface ships, however, the collateral damage incidence in much lower, about 15 percent. With sea water, the collateral damage incidence is at least 75 percent. It is concluded that the fire extinguisher water has to be contaminated, as by rust in sprinkler systems or deposited salt spray, for most collateral damage to occur. Reasons for inadvertant operation (or advertant operation) of firex systems at shore facilities, submarines, and surface ships resemble those for nuclear power plants. Mechanical or electrical failures lead the list, followed by mishaps during maintenance. Detector and alarm system failures are significant problems at Navy shore facilities, and significant at nuclear power plants. Fixed halon and CO2 systems in shore facilities cause no collateral damage. Lists of individual Navy incidents with water and with halon and carbon dioxide are included as appendices.
Author

N92-19947# CALS/CE, Washington, DC. Industry Steering Group.
FRAMEWORK FOR CONCURRENT ENGINEERING. REPORT OF THE CE FRAMEWORK TASK GROUP OF THE CALS/CE INDUSTRY STEERING GROUP
13 Mar. 1991 59 p
(PB92-102516; CALS-TR-003) Avail: NTIS HC/MF A04 CSCL 13B

The need for a generic concurrent engineering information architecture, constraints on its development, and implementation

issues is identified. The information architecture must allow a large multidisciplinary group to behave as a close-knit interdisciplinary team, creating, analyzing, modifying, and applying product data information in concurrent engineering. The document addresses process definition and description; product information attributes and features; information management and exchange; concurrent engineering implementation needs; resource consideration; concurrent engineering performance assessment and validation; and a transition roadmap. GRA

N92-19949# CALS/CE, Washington, DC. Industry Steering Group.
CONCURRENT ENGINEERING TECHNICAL INTERFACE PROCESS FLOW. REPORT OF THE CE TECHNICAL/ADMINISTRATIVE INTERFACE TASK GROUP OF THE CALS/CE INDUSTRY STEERING GROUP
9 Jul. 1991 73 p
(PB92-102532; CALS-TR-004) Avail: NTIS HC/MF A04 CSCL 13B

A general guide to the components of the Department of Defense (DoD) and Industry needed to describe the technical interfaces required for implementing concurrent engineering is provided. These interfaces address the key components of design, manufacturing, and logistic support in an integrated environment. This document is intended to provide a transition structure for the other concurrent engineering task groups to build a more complete definition of the concurrent engineering process. The document addresses the technical interfaces of the government's acquisition process and does not attempt to define the business relationships or interfaces of administering the acquisition process. GRA

N92-19953# National Inst. of Standards and Technology, Gaithersburg, MD.
METROLOGY FOR THE SEMICONDUCTOR INDUSTRY
R. I. Scace Sep. 1991 47 p
(PB91-240739; NISTIR-4653) Avail: NTIS HC/MF A03 CSCL 13B

The metrological needs of the semiconductor industry and its supporting materials and manufacturing equipment industries for the 1990's are set forth. Data is analyzed for their implications for measurement science and technology. A brief introduction is presented on the economic significance of the semiconductor industry, along with an overview of the relevant technologies, their development trends and the metrological needs thus implied, and evidence of needs expressed by sources outside of NIST. The need is examined for measurements of all kinds, but the means by which these may be met are not discussed. Author

N92-19320*# South Carolina Univ., Columbia. Dept. of Physics.
PRECISION CLEANING VERIFICATION OF NONVOLATILE RESIDUES BY USING WATER, ULTRASONICS, AND TURBIDITY ANALYSES
S. Ballou Skinner *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 441-468 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 13H

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-19037# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
PROBABILISTIC MODELING OF COMMON CHANNEL SIGNALING
Donald P. Gaver, Patricia A. Jacobs, and J. P. Lehoczky Sep. 1991 39 p
(AD-A244381; NPSOR-91-028) Avail: NTIS HC/MF A03 CSCL 12/4

This report details preliminary models for a common-channel signaling system that sets up and tears down voice calls in a circuit-switched network. The initial Sections 1 to 3 present alternative detailed models for a single link between circuit-switched nodes. Section 4 outlines a heuristic procedure for calculating delays in a network; it makes use of an M/G/1 queueing approximation partially justified earlier. The simple illustrative problem addressed suggests approaches to a realistic network. GRA

N92-19053# Columbia Univ., New York, NY. Dept. of Electrical Engineering.
ELECTRO-OPTIC GENERATION AND DETECTION OF FEMTOSECOND ELECTROMAGNETIC PULSES Final Report, 1 Aug. 1988 - 30 Sep. 1991
David H. Auston 20 Nov. 1991 30 p
(Contract F49620-88-C-0109)
(AD-A244276; AFOSR-91-1017TR) Avail: NTIS HC/MF A03 CSCL 20/15

Key accomplishments during this period are: (1) The successful demonstration of a new technique for generating subpicosecond electromagnetic pulses using large aperture photoconductors to produce directional and diffraction-limited beams of terahertz radiation; (2) The development of a new electrically-controlled phased array of photoconducting antennas for producing steerable terahertz radiation; (3) The extraction of femtosecond electromagnetic pulses from an electro-optic crystal following their generation by electro-optic Cherenkov radiation, and their subsequent propagation and detection in free space; (4) The measurement of subpicosecond electrical response of a new organic electrooptic material (polymer); (5) The observation of terahertz transition radiation from the surfaces of electro-optic crystals. GRA

N92-19065# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SPEECH RECOGNITION USING MULTIPLE FEATURES AND MULTIPLE RECOGNIZERS M.S. Thesis
Thomas F. Rathbun 3 Dec. 1991 312 p
(AD-A243791; AFIT/GCE/ENG/91D-7) Avail: NTIS HC/MF A14 CSCL 17/8

The purpose of this thesis is to demonstrate the feasibility of using multiple features and multiple recognizers to perform isolated word recognition. This is accomplished by performing multiple independent recognition tests and fusing the results together to get a single recognition result. The speech data is recorded and each word is extracted into a separate file. Eight features are calculated for each word. The features are calculated on 512 sample time slices and produce 16 component vector output. The three recognizers use the eight features to produce a total of 24 error distance lists. These lists are then fused together by adding the error values corresponding to each word. The word with the smallest fused error value is declared the recognition winner. Talker dependent and independent tests were run on a word set of zero through nine and A through Z. The talker dependent tests achieved

accuracies between 87 and 100 pcts. depending on the talker. The talker independent tests achieved accuracies between 81 and 97 pcts. GRA

N92-19136# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.

TARGET AND CLUTTER SCATTERING AND THEIR EFFECTS ON MILITARY RADAR PERFORMANCE

Sep. 1991 334 p In ENGLISH and FRENCH Meeting held in Ottawa, Ontario, 6-9 May 1991 Original contains color illustrations

(AGARD-CP-501; ISBN-92-835-0633-2) Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The symposium was organized into six sessions: two on clutter modeling and measurements, one on target scattering, one on signal processing, one on polarimetrics, one on applications, and two on classified topics. Specific topics covered include radar ground clutter measurements, a model of coherent radar land backscatter, parabolic equation modeling of backscatter from the rough sea surface, millimeter wave scattering from snow covered terrain, aspects of radar cross section calculation for targets of complex structure, grazing angle dependency of synthetic aperture radar, polarimetric monopulse radar scattering measurements at 95 and 225 GHz, and the reduction of target scattering by tropospheric modification. For individual titles, see N92-19137 through N92-19166.

N92-19137# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

RADAR GROUND CLUTTER MEASUREMENTS AND MODELS. PART 1: SPATIAL AMPLITUDE STATISTICS

J. Barrie Billingsley *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 15 p Sponsored in part by Dept. of National Defence (For primary document see N92-19136 10-32)

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We have collected a large multifrequency data base of radar clutter measurements from many sites. We employ our clutter data to develop clutter models. Of particular interest to us is the site-specific prediction of PPI ground clutter maps for ground sited radars. Discussed here are our measurements, a statistical clutter model for spatial amplitude statistics based on depression angle, terrain type, radio frequency, and radar resolution. Author

N92-19138# Defence Research Establishment, Ottawa (Ontario). Radar Div.

RADAR GROUND CLUTTER MEASUREMENTS AND MODELS. PART 2: SPECTRAL CHARACTERISTICS AND TEMPORAL STATISTICS

Hing C. Chan *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 14 p (For primary document see N92-19136 10-32)

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The results of the spectral analysis show that ground clutter, as observed by a coherent radar with a stationary antenna, comprises three components: a coherent component, a slow-diffuse component, and a fast-diffuse component. These components can be described by relatively simple models. The model parameters are functions of radar frequency, waveform resolution, land cover, and wind speed. The results of the statistical analysis show that the Ricean distribution and its limiting case, the Rayleigh distribution, are appropriate models for ground clutter amplitude statistics in steady state wind conditions. The relative frequency of fit of the ground clutter statistics to each model depends on radar frequency, land cover, and wind speed. However, at any given time, there is a significant proportion of resolution cells in a surveillance area which exhibits non-stationary statistics. This non-stationary statistical behavior was a consequence of rapidly changing wind conditions. The results presented here are of use for the development of ground clutter spectral and statistical models, constant false alarm rate (CFAR) processors, and algorithms for improved low velocity target detection. Author

N92-19139# GEC-Marconi Electronics Ltd., Chelmsford (England).

A MODEL OF COHERENT RADAR LAND BACKSCATTER

G. C. Sarno *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 11 p Sponsored in part by Ministry of Defence (For primary document see N92-19136 10-32)

(Contract F19629-85-C-0002; ARPA Order 3724)

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The detection of targets in a land clutter background is a problem for most ground based and airborne pulse Doppler radars. Understanding how ground clutter behaves can lead to modified clutter suppression techniques for improving radar target detection performance. Presented here is a model of land clutter which was validated against a number of different land types observed at different frequencies. The characteristics of the clutter which limit target detection are discussed. Author

N92-19140# Rome Air Development Center, Hanscom AFB, MA.

A MODEL FOR BISTATIC SCATTERING OF ELECTROMAGNETIC WAVES FROM FOLIAGE COVERED ROUGH TERRAIN

Robert J. Papa and Douglas T. Tamasanis (Arcon Corp., Waltham, MA.) *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p (For primary document see N92-19136 10-32)

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The problem of determining the electromagnetic (EM) power received by an antenna located over foliage covered rough terrain in a bistatic scattering geometry is important and quite complex. A model was developed which can quantitatively determine the effect of a foliage layer on EM waves scattered from rough terrain. The theoretical approximations obtained from this model are compared with data at two levels; the loss in penetrating the foliage and the total normalized scattering cross section sigma degrees. The results of this theoretical modeling are compared with experimental data at two levels. First, the effective dielectric constants for a foliage environment were used to calculate the attenuation constants of coherent waves propagating through a dense forest. The attenuation constants given by the model were compared with data taken at 200MHz, 500MHz and 800MHz, resulting in good agreement. Then, the entire bistatic scattering model was used to calculate an effective normalized scattering cross section (sigma degrees) for a sod field, grass, and forest covered terrain. This was compared with L-band data resulting in excellent agreement between theory and experimental data. Author

N92-19141# Rome Air Development Center, Hanscom AFB, MA.

BISTATIC SCATTERING STATISTICS OF DECIDUOUS TREES

K. V. N. Rao, W. G. Stevens, and J. Mendonca *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p (For primary document see N92-19136 10-32)

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Theoretical predictions have shown that significant variations in the power scattered by a rough surface exist when the orientation of a linearly polarized bistatic receiver is changed with respect to the transmitter polarization. Experiments conducted at laser frequencies have verified the existence of these polarization variations. This present work was performed to determine if this behavior could be observed at microwave frequencies at a field test site. The experimental results on the polarization dependence

of bistatic scattering from deciduous trees are described. The bistatic scattered power from foliage (mixture of Birch, Maple, Ash and grass) at 3.2 GHz was measured as a function of the receiver polarization angle. Here data for one configuration is reported: incidence angle of 80 degrees, elevation scattering angle of 84 degrees, and one azimuthal scattering angle of 105 degrees. The scattering surface size was approximately 4.5 square meters. A wide band (200 MHz) S-band radar system was used to conduct these measurements. Both vertically and horizontally polarized signals were transmitted. A brief discussion on the dependence of the location and depth of polarization nulls on the complex permittivity and roughness characteristics of the scattering surface is also given. Results of experiments show that measured and theoretical null locations are in reasonable agreement. Further measurements at additional azimuthal scattering angles will be made. Future plans include phase and amplitude measurements with a dual orthogonal-polarized receiving antenna to determine the ellipticity of scattered signals. Author

N92-19142# Mission Research Corp., Monterey, CA.
ALTAIR UHF OBSERVATIONS OF BACKSCATTER ENHANCEMENT
Dennis L. Knepp *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 7 p Previously announced in IAA as A91-42416 (For primary document see N92-19136 10-32)
(Contracts DNA001-87-C-0169; N00014-87-C-2336)
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During the Defense Nuclear Agency (DNA) PEAK (Propagation Effects Assessment - Kwajalein) experiment in Aug. 1988, the ALTAIR VHF/UHF wide bandwidth radar was used to track spherical satellites in low earth orbit. The purpose of the experiment was to obtain radar data during the most severe propagation disturbances available naturally. The PEAK experiment was quite successful, giving many measurements of strong scintillation as well as the first measurements of frequency selective fading on propagating radar pulses. The experimental results are used to show an enhancement, due to scattering, in the average received power that is observed during severe scintillation. The observed statistics of the enhancement are compared to analytic calculations using the Nakagami-m distribution with very good agreement. This enhancement is predictable on the basis of the first order amplitude statistics for two way radar propagation in a monostatic propagation geometry as well as by a more thorough analysis using reciprocity; both analytic approaches are presented. The enhancement is important for both ground and space based radars that have to operate during scintillation. Author

N92-19143# Rutherford Appleton Lab., Chilton (England). Radio Communications Research Unit.
PARABOLIC EQUATION MODELLING OF BACKSCATTER FROM THE ROUGH SEA SURFACE
M. F. Levy *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 10 p (For primary document see N92-19136 10-32)
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A physically based numerical method is presented for calculating sea clutter at low grazing angles for microwave frequencies. Sea clutter is modeled as a two scale phenomenon: at low grazing angles, the backscattered energy is generated by ripples on the sea surface. A first order perturbation method gives the backscatter from a small patch of surface, as a function of the angle of incidence and of the magnitude of the incident field. Returns from a clutter cell are obtained by incoherent summation of these echoes. Shadowing and tilting effects due to the larger scale components of the sea surface are modeled using a finite difference implementation of the parabolic equation method, which also deals with atmospheric refraction effects. Realizations of the sea surface with the desired spectral characteristics are generated with a Monte Carlo method. Results are presented at S band and X band for a variety of propagation conditions. Author

N92-19144# Pisa Univ. (Italy). Dept. of Information Engineering.
EXPERIMENTAL CHARACTERIZATION OF AMPLITUDE DISTRIBUTION OF MEDITERRANEAN SEA CLUTTER
G. Corsini, E. DalleMese, M. DePalo, A. M. Ricci, L. Vanni (Naval Academy, Livorno, Italy), and L. Verrazzani *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 10 p (For primary document see N92-19136 10-32)
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Some results are presented relevant to experimental characterization of Mediterranean sea clutter. The data were collected by using an X band coastal radar sited on an Italian Navy area in Livorno. The aim is the collection of clutter samples in different conditions (weather conditions, carrier frequency, polarization and radar site) for clutter models validation, performance assessment and optimization of the radar processor. Author

N92-19145# Michigan Univ., Ann Arbor. Radiation Lab.
MODELING AND MEASURING MILLIMETER-WAVE SCATTERING FROM SNOW-COVERED TERRAIN
Fawwaz T. Ulaby, Yasuo Kuga, and Richard Austin *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 11 p (For primary document see N92-19136 10-32)
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A radiative transfer model was developed for characterizing radar backscatter from snow covered ground at millimeter wavelengths. The model was used to evaluate the radar response to incidence angle, snow depth, snow surface roughness, and snow liquid water content, for both like and cross polarization configurations. The model behavior was compared with experimental observations made at 35, 95, and 140 GHz, including observations over diurnal cycles. The experimental data were acquired during the 1989 and 1990 winter seasons in Michigan using a truck mounted millimeter wave scatterometer system capable of observing the ground surface over a wide range of incidence angles for all linear combinations of transmit and receive antenna polarizations. Comparison of the measured data with model calculations revealed excellent agreement for dry snow as well as when the surface layer of the snowpack was wet. However, when the surface layer was dry and lower layers wet, the model results were inconsistent with the radar observations. To deal with the general case wherein the liquid water content exhibits a nonlinear profile with depth, a hybrid numerical first order solution of the radiative transfer model was developed. Author

N92-19146*# Ohio State Univ., Columbus. ElectroScience Lab.
ANALYTICAL PREDICTION OF EM SCATTERING BY COMPLEX OBSTACLES WITHIN ELECTRICALLY LARGE OPEN CAVITIES
Prabhakar H. Pathak *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 6 p Sponsored in part by GE (For primary document see N92-19136 10-32)
(Contract NAG3-476; N00014-89-J-1007)
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An analytical technique is described for predicting the electromagnetic (EM) scattering by complex obstacles within electrically large open waveguide cavities. This topic is of relevance to EM scattering and EMC type applications. A general open ended waveguide cavity is illustrated and is assumed to be relatively arbitrarily shaped, and the open front end of the cavity is illuminated by an arbitrarily polarized external plane wave field. The interior obstacle is assumed to be located within the cavity near the back

end, and it generally contributes significantly to the fields scattered into the exterior by the entire cavity configuration. The present scattering analysis is restricted to within approximately 70 degs from boresight with respect to the open front end; outside of this region, the scattering by the external features of the cavity are generally more significant than from the interior of the cavity. The scattering analysis is composed of two main parts. One analysis is of the coupling of the incident plane wave field, via the open front end using the high frequency ray or beam shooting methods. The other analysis deals with separately obtaining the plane wave scattering characteristics of the interior obstacle. Thus the present analysis represents a hybrid combination of an asymptotic high frequency ray/beam method for tracking the fields through the cavity, together with any suitable method for obtaining a plane wave characterization of the interior obstacle. Author

N92-19147# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. fuer Hochfrequenztechnik.

RCS PREDICTION MODELS BASED ON PO AND PTD AND STATE OF VALIDATION

V. Stein *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 15 p Sponsored in part by Bundesamt fuer Wehrtechnik und Beschaffung (For primary document see N92-19136 10-32)

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In the microwave case the scattering matrix of complicated targets is often evaluated on the basis of physical optics (PO). In cases where edge diffraction effects become relevant, the physical theory of diffraction (PTD) is used to correct the PO field. Both methods are applied in another paper to determine the radar cross section (RCS) of a series of perfectly conducting structures; a thin flat plate, a thin cylinder, a cone cylinder half sphere, a double dihedral, and a periscope-like object. Since the geometric model of each object consists of panels, internal and external tests were made to estimate the deviations between the true surface and the model surface which can be tolerated to guarantee sufficient accuracy. All predicted RCS values are compared either with measurements or with independent theoretical results as references. Conclusions for the accuracy of PO and PTD are drawn and further work is discussed. Author

N92-19148# Hochschule der Bundeswehr, Hamburg (Germany, F.R.). Inst. of Automation.

ASPECTS OF RADAR-CROSS-SECTION CALCULATION FOR TARGETS OF COMPLEX STRUCTURE

O. Weiland and J. Wendiggensen *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p (For primary document see N92-19136 10-32)

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Minimizing the Radar Cross Section (RCS) of a new warship, it is important to determine the expected RSC in the design phase because of high development costs. Furthermore, it is desirable to identify design dependent scattering centers and analyze their mode of action. This is done most effectively by a graphical representation of the scattering mechanisms on a 3-D drawing of the target itself. The development is summarized of a computer code that combines graphical representation methods with well established theoretical techniques to predict the RCS for targets of complex structures. The tool is based on physical optics, physical theory of diffraction, ray tracing and it accounts for multiple shadowing and scattering up to triple bounce. The method of component technique using primitives is applicable to electrically large bodies and the calculation is limited to the monostatic case for perfectly conducting surfaces. Object coherence is used to reduce computation time during the solution of the hidden surface problem. Author

N92-19149# Ecole Royale Militaire, Brussels (Belgium). Dept. of Mathematics.

RCS CALCULATIONS OF 3-DIMENSIONAL OBJECTS, MODELED BY CAD

I. DeLeeneer, E. Schweicher, and A. Barel (Vrije Univ., Brussels, Belgium) *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 9 p (For primary document see N92-19136 10-32)

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All the steps are detailed that one has to perform to enable efficient Radar Cross Section calculation for objects with a complex and general shape. Only cavities are supposed to be nonexistent at this state of the work. Before the actual RCS calculations, preliminary treatments like systematic modeling, Hidden Faces removal, and automatic recognition of reflection and diffraction centers are realized. After the creation of the object's geometry and its adaptation to the direction of the observator, Physical Optics (PO) was used to determine the backscattered field, and Geometrical Theory of Diffraction (GTD) was used to evaluate the diffracted fields. Only monostatic scattering (i.e., backscattering) is considered. Author

N92-19150# MATRA Espace, Paris-Velizy (France).

HIGH-FREQUENCY CAD-BASED SCATTERING MODEL: SERMAT

D. Goupil and M. Boutillier *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p In FRENCH; ENGLISH summary (For primary document see N92-19136 10-32)

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Specifications for an industrial radar cross section (RCS) calculation code are given: it must be able to exchange data with many computer aided design (CAD) systems, it must be fast, and it must have powerful graphic tools. Classical physical optics (PO) and equivalent currents (EC) techniques have proven their efficiency on simple objects for a long time. Difficult geometric problems occur when objects with very complex shapes have to be computed. Only a specific geometric code can solve these problems. We have established that, once these problems have been solved: (1) PO and EC give good results on complex objects of large size compared to wavelength; and (2) the implementation of these objects in a software package (SERMAT) allows fast and sufficiently precise domain RCS calculations to meet industry requirements in the domain of stealth. Author

N92-19151# Alenia, Torino (Italy).

PARAMETRIC BICUBIC SPLINE AND CAD TOOLS FOR COMPLEX TARGETS SHAPE MODELLING IN PHYSICAL OPTICS RADAR CROSS SECTION PREDICTION

A. Delogu and F. Furini *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 13 p (For primary document see N92-19136 10-32)

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Increasing interest in radar cross section (RCS) reduction is placing new demands on theoretical, computation, and graphic techniques for calculating scattering properties of complex targets. In particular, computer codes capable of predicting the RCS of an entire aircraft at high frequency and of achieving RCS control with modest structural changes, are becoming of paramount importance in stealth design. A computer code, evaluating the RCS of arbitrary shaped metallic objects that are computer aided design (CAD) generated, and its validation with measurements carried out using ALENIA RCS test facilities are presented. The code, based on the physical optics method, is characterized by an efficient integration algorithm with error control, in order to contain the computer time within acceptable limits, and by an accurate parametric representation of the target surface in terms of bicubic splines. Author

N92-19152# Electronique Marcel Dassault, Saint Cloud (France).
RADAR CROSS SECTION MEASUREMENTS IN VHF/UHF
Jacques Saget *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 6 p In FRENCH (For primary document see N92-19136 10-32)
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Scientists and technicians tasked with developing future radar systems are becoming increasingly interested in the UHF and VHF bands. Some such systems, especially Soviet ones, have existed for several decades and are used for long distance surveillance and advance alert for ABM missiles. Some of the advantages for tactical and strategic military applications are the stealth weapons and missiles and hidden targets, undetectable at hyperfrequency bands, can be detected at VHF/UHF, and propagation in these bands is relatively unaffected by weather conditions such as snow, rain, or cloud cover. Some of the difficulties linked to radar cross section (RCS) measurement in VHF/UHF are the need for an adequate illumination system, elimination of surrounding clutter, instrumentation, and processing. Techniques for overcoming each of these difficulties are discussed and anechoic chamber experiments carried out in order to verify specific implementations are described. Author

N92-19153# Forschungsinstitut fuer Funk und Mathematik, Wachtberg (Germany, F.R.).
TWO-DIMENSIONAL SIGNAL PROCESSING FOR AIRBORNE MTI
Richard Klemm and Joachim Ender *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 7 p (For primary document see N92-19136 10-32)
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An overview of the field of airborne moving target indicator (AMTI) systems is given. For introduction, the problems of airborne MTI is pointed out. Well-known techniques such as conventional MTI and displaced phase center antenna (DPCA) are briefly described. Then, a prospective view of future AMTI-techniques is presented, including an overview of work on novel algorithms, techniques for airborne slow target extraction (TASTE). Although airborne radar is particularly addressed, the results may, with some modifications, be applied to other moving sensor configurations, such as active sonar, spaceborne radar, and synthetic aperture radar (SAR). This is intended to be tutorial and gives an overview of the state of the art in AMTI techniques. Author

N92-19154# Alberta Research Council, Edmonton (Canada). Environmental Research and Engineering Dept.
THE APPLICATION OF LATTICE-STRUCTURE ADAPTIVE FILTERS TO CLUTTER-SUPPRESSION FOR SCANNING RADAR
C. Gibson *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 10 p Sponsored in part by Natural Sciences and Engineering Research Council (For primary document see N92-19136 10-32)
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The use of an adaptive filter to enhance the detection of moving targets in the presence of clutter is described. The scanning and pulsing rates of a typical surveillance radar produce, within each resolution cell, a time-series of samples at a given range, resulting from the consecutive pulses. In the case of coherent radar, this time-series corresponds to the Doppler spectrum of that resolution cell, containing radial velocity information on both targets and clutter within the cell. An adaptive filter can be used to enhance the target signal over the clutter signal by matching the clutter spectrum, thus whitening the filter output, so that only the target's spectral components stand out. It is possible for the filter to discriminate between the clutter spectrum and the target spectrum because clutter is generally a diffuse source, spread over many adjacent cells, while the target is generally a point source, occupying a single cell. The adaptive digital-filtering structure examined was the lattice-structure prediction-error filter. A number of adaptation algorithms were examined for this structure, with the best results being obtained with the harmonic-mean algorithm. Within this algorithm, two gradient methods were examined for adaptation in a nonstationary environment. To test these algorithms and methods, coherent radar data was gathered from a 10 cm air traffic control surveillance radar. This data included different targets (aircraft and bird flocks) in a variety of clutter conditions (ground, rain, ice pellet, snow, and anomalous propagation clutter). Quantitative results are presented, including improvement factors and sub-clutter visibility factors, that show significantly better performance for these adaptive filters, when compared with conventional moving-target-indicator filters.
Author

N92-19155# Aeritalia S.p.A., Rome (Italy).
USE OF TARGET SPECTRUM FOR DETECTION ENHANCEMENT AND IDENTIFICATION
S. Pardini, P. F. Pellegrini (Florence Univ., Italy), and P. Piccini *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p (For primary document see N92-19136 10-32)
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Modulation on the echo signal generated by rotating machinery of an air target is addressed. An extensive measurement campain was carried out by means of an air traffic control radar and some preliminary results are presented. The problem of target spectra characterization and exploitation for detection enhancement and target identification, is considered in relation with the limitation imposed by the present radar features. Some considerations regarding the application of this technique for non-cooperative target recognition, in the radar of future generation, are developed. Author

N92-19156# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SAR IMAGE CLASSIFICATION FOR TARGET DETECTION
A. Beaupere and G. Foulon *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 8 p In FRENCH Previously announced in IAA as A91-45627 (For primary document see N92-19136 10-32)
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A simple method for classifying synthetic aperture radar (SAR) images is presented which relies on knowledge of surface roughness and radar backscattering. The proposed simulation algorithm, based on 2-D Fourier transformations, makes it possible to extract various types of urban zones from ground clutter independently on the polarization or inclination. The inverse problem is also treated, and a method for simulating SAR texture on the basis of a 3-D model of surface roughness is proposed. The results obtained are verified on the basis of Varan S images of Neuf-Brisach-Freiburg and Oberpfaffenhofen. Author

N92-19157# Aerospatiale, Cannes (France). Groupe Teledetection.
COMPARISON OF THE DETECTION AND RECONNAISSANCE CAPABILITIES OF AN HH-VV BIPOLAR IMAGING RADAR AND AN HH-HV-VH-VV POLARIMETER
J. M. Nasr *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 8 p In FRENCH Original contains color illustrations (For primary document see N92-19136 10-32)
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From the perspective of putting into orbit an observation satellite carrying a military-configuration synthetic aperture radar (SAR), it is important to consider simultaneous measurements of several polarizations to increase system performance. However, the effect of these techniques on data flow is not negligible to the looked-for results. Thus, it is necessary to analyze the impact of these new multipolar methods in terms of improved performances in detecting

and recognizing targets and to reach a compromise with classic methods (very high resolution). This article aims to quantify detection-recognition performance of a configuration of highlights using a multipolar imaging radar. Thus, we can confirm that HH-VV bipolarization is sufficient in many cases and that it is not necessary to measure HC and HH crossed channels that are very costly in terms of technology. Author

N92-19158# Institut de Recherche et d'Enseignement Superieur aux Techniques de l'Electronique, Nantes (France).
CONTRIBUTION OF POLARIMETRY IN RADAR TARGETS DISCRIMINATION, CLASSIFICATION, AND IDENTIFICATION
E. Pottier and J. Saillard *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p In FRENCH (For primary document see N92-19136 10-32)
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Currently, close analysis of a radar target in terms of its characterization and recognition, is of central interest to scientific research. This article is concerned with the improvement of the ability to discriminate and classify highlights of a target by introducing the concept of polarimetry in the domain of high resolution electromagnetic imagery. Transl. M.G.

N92-19159# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE USE OF POLARIZATION FOR FINE ANALYSIS OF RADAR TARGETS
C. Titin-Schnaider *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 7 p In FRENCH Previously announced in IAA as A91-45639 (For primary document see N92-19136 10-32)
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It is demonstrated that the introduction of polarization in radar holography provides high-resolution images linking a complex 2 x 2 matrix to each pixel. The 'highlights' model shows that these matrices correspond to backscattering matrices associated with electromagnetic interactions at the pixel level. Polarimetry is applied at the level of these elementary backscattering matrices. Experimental measurements carried out for various targets confirm that polarimetry applied at the pixel level of a high-resolution radar image can make it possible to determine the nature of 'shining points'. Author

N92-19160# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wesseling (Germany, F.R.). Inst. for Radio Frequency Technology.
POLARIMETRIC COVARIANCE MATRIX ANALYSIS OF RANDOM RADAR TARGETS
E. Lueneburg, V. Ziegler, A. Schroth, and K. Tragl *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p (For primary document see N92-19136 10-32)
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Two equivalent approaches for the description of mean polarimetric backscattering features of random radar targets exist, the so-called Mueller matrix and the covariance matrix approach. The covariance matrix contains measurable radar observables and is directly related to the statistics of the elements of the scattering matrix which determines the instantaneous backscattering features of a target. In this paper, a covariance matrix analysis for reciprocal random targets is performed by unitary transformations preserving important polarimetric invariances. The derivatives of covariance matrix elements with respect to the transmitter polarization reveal interesting functional relations between characteristic polarization states and covariance matrix elements. Analytical and numerical algorithms to determine optimal polarizations for cross- and copolar power are presented. The connection of the covariance matrix approach with the Mueller matrix formulation is shown in detail. Polarimetric covariance matrix analysis is illustrated by polarimetric radar measurements of terrain, rain and manmade clutter, and documented with according graphical evaluation. Author

N92-19161# Michigan Univ., Ann Arbor. Radiation Lab.
MILLIMETER WAVE POLARIMETRIC SCATTEROMETER SYSTEMS: MEASUREMENT AND CALIBRATION TECHNIQUES
Y. Kuga, K. Sarabandi, A. Nashashibi, F. T. Ulaby, and R. Austin *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 5 p (For primary document see N92-19136 10-32)
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The target and system phase-stability during the time to measure the scattering matrix is a major problem for millimeter wave polarimetric radars. This is particularly true for network analyzer-based systems. To circumvent this phase-stability problem, we have developed new fully polarimetric radars at 35 and 94 GHz. The system is based on a relatively inexpensive network analyzer and is capable of operating in either the coherent or the incoherent polarimetric measurement mode. In the coherent mode, the scattering matrix can be measured within 2 ms. In the incoherent mode, the average Mueller matrix is measured directly by transmitting four different polarizations and measuring the Stokes vector of the backscattered signal. To compare the performance of the true measurement modes, the average Mueller matrix and the statistics of the phase difference of the two co-polarized signals were measured for a rhododendron tree and for a metallic tree. The average Mueller matrices obtained from the coherent and incoherent polarimetric measurement modes were similar. The target motion during the data acquisition period did not change the average Mueller matrix in the incoherent measurement mode. The probability density function of the phase difference of the two co-polarized signals computed from the average Mueller matrix is essentially the same as the one measured with the coherent polarimetric measurement mode. Author

N92-19162# Massachusetts Univ., Amherst. Microwave Remote Sensing Lab.
POLARIMETRIC TECHNIQUES AND MEASUREMENTS AT 95 AND 225 GHz
James Mead, Robert McIntosh, Phillip Langlois, and Paul Chang *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 10 p (For primary document see N92-19136 10-32)
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The University of Massachusetts has developed two high-power portable polarimetric radars operating at 95 and 225 GHz. The 95 GHz coherent polarimeter is configured to measure the complex scattering matrix of a target by transmitting a pair of orthogonally polarized pulses in rapid succession. We have also developed a noncoherent 225 GHz polarimetric radar which directly characterizes the target Mueller matrix by transmitting a sequence of four or six polarization states. In addition to reviewing the radar design and calibration, this paper summarizes measurements of natural and man-made objects made to date. These measurements include several varieties of trees, terrain, and snowcover. A model which approximates the Mueller matrix with a single parameter is introduced for a restricted class of clutter and is found to accurately predict the polarimetric behavior of vegetation and terrain at low incidence angles. We also present a two parameter approximation of the Mueller matrix that accurately models scattering from snowcover at large incidence angles. Author

N92-19163# Harry Diamond Labs., Adelphi, MD.
POLARIMETRIC MONOPULSE RADAR SCATTERING MEASUREMENTS OF TARGETS AT 95 GHz
R. J. Wellman, J. Nemarich, H. Dropkin, D. R. Hutchins, J. L. Silvious, and D. A. Wikner *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 13 p (For primary document see N92-19136 10-32)

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This paper describes a 95-GHz polarimetric monopulse instrumentation radar and selected scattering measurement results for an armored vehicle. The radar is all-solid-state, coherent, frequency steppable over a 640-MHz bandwidth, and completely polarimetric for linearly or circularly polarized radiation. Details of the methods used to perform the amplitude and phase calibrations and the effectiveness of polarization distortion matrix corrections are included in the paper. Measurements made with the radar of various vehicles on a turntable have allowed quasi-three-dimensional polarimetric ISAR images of the targets to be generated. Sample images for an infantry combat vehicle are presented together with high-resolution range profiles of the target for all monopulse channels. Author

N92-19164# Rutherford Appleton Lab., Chilton (England). Radio Communications Research Unit.

REDUCTION OF TARGET SCATTERING BY TROPOSPHERIC MODIFICATION

K. H. Craig *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 12 p Sponsored by European Office of Aerospace Research and Development (For primary document see N92-19136 10-32)

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This paper examines the possibility of reducing the effective radar cross-section of an aircraft by actively modifying the refractive index of the air surrounding it. The mechanism proposed is heating of the atmosphere by a laser mounted on the aircraft. The equations for the refractive index changes caused by absorption of laser radiation are derived, and refractive index profiles are calculated. A shielding factor specifying the reduction in target cross-section is introduced. The shielding factor is evaluated for typical laser beam geometries by using these profiles in a parabolic equation based electromagnetic propagation model. A parametric study is presented in order to optimize the laser wavelength and beam geometry. It is concluded that laser powers in the megawatt range can yield shielding factors greater than 10 dB. A 10.6 micron CO2 laser appears to be optimum in terms of efficiency of cross-section reduction, and is also the laser type for which the highest CW powers are achievable. Author

N92-19165# Smith Associates Ltd., Guildford (England).

STOCHASTIC MODEL OF TERRAIN EFFECTS UPON THE PERFORMANCE OF LAND-BASED RADARS

S. P. Tonkin and M. A. Wood (Royal Signals and Radar Establishment, Malvern, England) *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 9 p Sponsored in part by Ministry of Defence (For primary document see N92-19136 10-32)

(Contract F19628-85-C-0002; ARPA Order 3724)

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A stochastic model of land clutter visibility and of terrain screening of targets, with particular application to low-flying targets under surveillance by a microwave land-based radar system, is described. The model is not site specific, but it is detailed. It allows radar performance measures such as the mean length of track to be obtained analytically, without averaging large numbers of site specific simulations or requiring high fidelity terrain data. The trajectories of terrain-following targets are described in terms of ensembles of Markov processes. The main dependencies of the model are the following: terrain relief; radar height; target altitude; and distance of closest approach between the target and the radar. The model can be used to generate simulated clutter maps and target screening diagrams, and indeed this is done to compare the model results with experimental data. However, the main aim is to predict the effects of target screening and land clutter directly from the model, rather than from large numbers of simulations. Author

N92-19166# Alberta Research Council, Edmonton (Canada). Environmental Research and Engineering Department.

OVERVIEW OF WEATHER CLUTTER RESEARCH AT THE ALBERTA RESEARCH COUNCIL

C. Gibson and B. Kochtubajda *In* AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance Sep. 1991 8 p (For primary document see N92-19136 10-32)

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The Alberta Research Council operates a unique variable polarization-diversity 10 cm radar at its facility in Penhold, Alberta (located adjacent to CFB Penhold, at 52.2 deg N, 113.8 deg W, and elevation 904 m). This radar is part of a meteorological radar complex owned and operated by the Alberta Research Council. This facility, which also includes 5 cm and 3 cm radars, is primarily used for meteorological and radio propagation research. Author

N92-19191*# Hughes Aircraft Co., Torrance, CA.

HIGH-EFFICIENCY 20 GHz TRAVELING WAVE TUBE DEVELOPMENT FOR SPACE COMMUNICATIONS Final Report

S. L. Aldana and R. N. Tamashiro Oct. 1991 93 p

(Contract NAS3-24897)
(NASA-CR-187160; NAS 1.26:187160) Avail: NTIS HC/MF A05 CSCL 09A

A 75 watt CW high efficiency helix TWT operating at 20 GHz was developed for satellite communication systems. The purpose was to extend the performance capabilities of helix TWTs by using recent technology developments. The TWT described is a unique design because high overall efficiency is obtained with a low perveance beam. In the past, low perveance designs resulted in low beam efficiencies. However, due to recent breakthoughs in diamond rod technology and in collector electrode materials, high efficiencies can now be achieved with low perveance beams. The advantage of a low perveance beam is a reduction in space charge within the beam which translates to more efficient collector operation. In addition, this design incorporates textured graphite electrodes which further enhance collector operation by suppressing backstreaming secondaries. The diamond supported helix circuit features low RF losses, high interaction impedance, good thermal handling capability and has been designed to compensate for the low perveance beam. One more discussed tube feature is the use of a velocity taper in the output helix that achieves low signal distortion while maintaining high efficiency. Author

N92-19194# Calspan-Buffalo Univ. Research Center, NY.

ADVANCED SIGNAL PROCESSING TECHNIQUES Final Report

B. Andriamanalimanana, J. Novillo, and S. Sengupta Oct. 1991 66 p

(Contract F30602-88-D-0026)
(AD-A244148; RL-TR-91-262) Avail: NTIS HC/MF A04 CSCL 12/7

The research efforts under this program have been in the area of parallel and connectionist implementations of signal processing functions such as filtering, transforms, convolution and pattern classification and clustering. The topics which have been found to be the most promising, in as far as their novelty, and applicability to the classification of pulses are covered in the following four sections: (1) Algebraic Transforms and Classifiers, (2) An Interaction Model of Neural-Net based Associative Memories, (3) Models of Adaptive Neural-Net based Pattern Classifiers, and (4) Discrete Fourier Transforms on Hypercubes. GRA

N92-19196# Rockwell International Science Center, Thousand Oaks, CA.

DISTRIBUTED PROCESSING IN MULTI-HOP PACKET RADIO NETWORKS Final Report, 1 Aug. 1989 - 30 Jul. 1991

A. R. Sastry Aug. 1991 67 p

(Contract DAAL03-89-C-0017)
(AD-A244160; SC71013.FR; ARO-25366.4-EL) Avail: NTIS HC/MF A04 CSCL 25/2

This report is concerned with the integrated evaluation of distributed processing scenarios in a highly dynamic environment

such as a multi-hop packet radio network. To aid in this process, a simulation model was developed that has a network of identical packet radio nodes using spread spectrum random access protocols, an error model for multiple access interference and on-off partial band jammer, and end-to-end transport functions. An abstract description of a typical distributed processing scenario with hierarchical primary and subtask structures has been devised based on a 'script' that specifies processing time, sequences of subtasks (distributed over other nodes) and lengths of request and response messages and was integrated with the packet radio simulation. Extensive numerical results, primarily in the form of percent of successfully completed tasks and the mean task delay, were obtained through simulation runs representing a wide variety of task scenarios. Different processing scenarios such as assignment of task deadlines, levels of task-subtask hierarchy, and redundant processing of a subtask on multiple hosts, have also been examined. Author (GRA)

N92-19200# Massachusetts Inst. of Tech., Westford.
DURIP INSTRUMENTATION SUPPORT FOR HIGH-LATITUDE IONOSPHERIC RESEARCH AND THE ESTABLISHMENT OF A DUAL RADAR/DUAL FREQUENCY OBSERVATIONAL CAPABILITY AT THE MILLSTONE RADAR FACILITY Final Report, 1 Dec. 1988 - 30 Jun. 1991
John C. Foster 28 Oct. 1991 7 p
(Grant AF-AFOSR-0169-89; AF Proj. 3842)
(AD-A244169; AFOSR-91-0945TR) Avail: NTIS HC/MF A02 CSCL 17/9

Radar receiver and signal processing instrumentation was acquired and fabricated in order to establish a capability for dual 440 MHz and 1390 MHz radar operations at the M.I.T. Millstone Hill research facility. Hardware costs for a duplicate of the MIDAS radar processor were provided. This instrumentation enables a program of simultaneous, high-spatial resolution dual frequency observations of non-thermal and coherent radar backscatter from ionospheric plasma waves and turbulence at both F and E region heights. Simultaneous operation of the fully steerable Millstone Hill UHF and L-band radars in the incoherent scatter mode addresses the spatial homogeneity and simultaneity of ionospheric effects and processes. GRA

N92-19214# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A COMPARATIVE STUDY OF SPECKLE REDUCTION FILTERS IN SAR IMAGES AND THEIR APPLICATION FOR CLASSIFICATION PERFORMANCE IMPROVEMENT
Nelson Delfino Davil Mascarenhas, Sergio Eigi Ono, David Fernandes, and Hermann Joham Heinri Kux (Instituto Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil) Oct. 1991 16 p Presented at the 24th International Symposium on Remote Sensing of Environment, Rio de Janeiro, Brazil, 27-31 May 1991
(INPE-5294-PRE/1699) Avail: NTIS HC/MF A03

An experimental comparative study among several Synthetic Aperture Radar image speckle reduction filters proposed in the literature was made. This comparison was performed in terms of the equivalent number of looks (ENL) of the filtered images obtained from a SAR-580 image over Freiburg, Germany, with one look and linear detection. The compared filters include: box, median, Frost, Lee, Kuan-Nathan, and adaptive windowing versions of the last two filters. The filters by Frost and Kuan-Nathan that were originally proposed for quadratic detection (exponential distribution) were proposed to take into account the Rayleigh distribution that characterizes the data, obtained through linear detection. Furthermore, a classification procedure was performed over the same area, showing that a considerable improvement in performance was obtained by reducing the speckle noise prior to the classification. Author

N92-19217*# Ohio State Univ., Columbus. ElectroScience Lab.
ANALYSIS OF LOSSY COMPOSITE TERMINATING STRUCTURES
R. Andre, A. Dominek, J. Munk, and N. Wang Sep. 1991 69 p
(Grant NAG3-1000)
(NASA-CR-189901; NAS 1.26:189901; TR-723224-3) Avail: NTIS HC/MF A04 CSCL 20N

A finite element solution and computer code for the electromagnetic scattering of inhomogeneous penetrable bodies is presented. The application for the code is for the analysis and design of leading and trailing edge terminations when conducting and nonconducting materials are used. Examples of simple triangular shaped terminations are also presented. Author

N92-19239# Naval Postgraduate School, Monterey, CA.
PLANE WAVE SCATTERING FROM CIRCULAR AND HOLLOW CIRCULAR SLIT CYLINDERS USING THE ON-SURFACE RADIATION CONDITION (OSRC) APPROACH M.S. Thesis
Syed M. Ali Dec. 1990 79 p
(AD-A243793) Avail: NTIS HC/MF A05 CSCL 20/14

A new formulation of electromagnetic wave scattering by convex, two dimensional conducting bodies was introduced. This formulation, called the On Surface Radiation Condition (OSRC) approach is based upon an expansion of the radiation condition applied directly on the surface of the scatterer. Past approaches involved applying a radiation condition at some distance from the scatterer in order to achieve a nearly reflection free truncation of a finite difference time domain lattice. Application of a suitable radiation condition directly on the surface of the convex conducting scatterer can lead to substantial simplification of the frequency domain integral equation for the scattered field, which is reduced to just a line integral. In this thesis, the application of the second order radiation boundary condition to concave and re-entrant two dimensional bodies is considered. The specific shapes considered are slit circular cylinders and thick semi-circular cylinders. The formulation is done for the more challenging case of Transverse Electric (TE) polarization. The bodies considered here are two dimensional in nature and are perfectly conducting. Results are presented for the surface current distribution and scattering width of these cylinders and comparison is made with known results. It was found that the OSRC approach may not be applicable to concave structures and also for higher values of kb for convex bodies. GRA

N92-19262# Naval Postgraduate School, Monterey, CA.
A RING MODEL FOR LOCAL/MOBILE RADIO COMMUNICATIONS WITH CORRECT PACKET CAPTURE M.S. Thesis
Kim J. Tran Mar. 1991 81 p
(AD-A243796) Avail: NTIS HC/MF A05 CSCL 25/2

Researchers and scientists have been studying Aloha networks for many years, hoping to improve the channel throughput and overcome the inherent instability. It this study, we are going to describe some of the Aloha network features. An application of the slotted Aloha network is considered for local/mobile radio communications, the near/far effect, Rayleigh fading, and shadow fading arise in local/mobile radio communications due to differences in distances and topography between each of the users and the base station. These various effects cause a packet capture effect which improves overall channel throughput, but leads to different packet delay times for various users. An analysis of a ring model for local/mobile radio communications with correct packet capture is considered. The correct packet capture effect of one ring and three ring networks is studied. A Markov model is developed for a slotted Aloha network with capture. It is shown that the throughput in such a network is markedly greater than the standard 1/e. Perhaps even more important is the result that such networks are more stable under overload. Author (GRA)

N92-19269# Sandia National Labs., Albuquerque, NM.
WAVENUMBER-DOMAIN SAR FOCUSING FROM A NONUNIFORM SYNTHETIC APERTURE
T. J. Flynn 1991 12 p Presented at the 1992 IEEE International Conference on Acoustics, Speech and Signal Processing, San Francisco, CA, 23-26 Mar. 1992
(Contract DE-AC04-76DP-00789)

(DE92-003640; SAND-91-1633C; CONF-920354-1) Avail: NTIS HC/MF A03

In the wavenumber-domain concept of SAR imaging, frequency-domain radar data are used to reconstruct a portion of the 2-D Fourier transform of the scene, which is then inverted to create the image. The method suffers no inherent limits on aperture length or scene size. This paper extends the concept to the case where the synthetic aperture is not a straight line and the samples are unevenly spaced. An accumulation formula for wavenumber-domain reconstruction is derived and shown to be equivalent to previously derived algorithms in the uniform-aperture case. It is then shown how data with three-dimensional irregularity in the aperture can be processed using height correction and mapping into the same plane. DOE

N92-19270# Los Alamos National Lab., NM.
SUPPRESSION OF ADJACENT-CHANNEL AND COCHANNEL FM INTERFERENCE VIA EXTENDED KALMAN FILTERING
J. N. Bradley Nov. 1991 6 p Presented at the 1992 IEEE International Conference on Acoustics, Speech and Signal Processing, San Francisco, CA, 23-26 Mar. 1992
(Contract W-7405-eng-36)
(DE92-003784; LA-UR-91-3692; CONF-920354-2) Avail: NTIS HC/MF A02

A method is discussed for the problem of demodulating an FM signal in the presence of an adjacent-channel or cochannel interferer. State-space descriptions of the underlying message processes and the measurement process are presented which are then incorporated in an extended Kalman filter framework. The extended filter was necessary due to the nonlinearity of the measurement equation. The results of computer simulations are presented which demonstrate the system performance for various selections of the modulation index and signal separation. The derived system is contrasted to the previous state of the art in this area which involved maximum likelihood estimation. DOE

N92-19272# Lawrence Livermore National Lab., CA.
HELMHOLTZ BEAM PROPAGATION BY THE METHOD OF LANCZOS REDUCTION
J. A. Fleck, Jr. Aug. 1991 12 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract W-7405-eng-48)
(DE92-003974; UCRL-JC-108128; CONF-9109230-10) Avail: NTIS HC/MF A03

The solution of the Helmholtz wave equation requires the application of an exponentiated square root operator to an initial field. This operation is greatly facilitated by the introduction of a representation in which the aforementioned operator is diagonal. The Lanczos method allows the diagonalization to be performed in a low dimensional space, e.g., of the order of 4-6, if one is interested in advancing the field over a limited propagation step of length Delta z. Although some boundary conditions may be ill-posed for the unapproximated Helmholtz equation, in the sense that certain plane wave components cannot propagate in the forward direction, the Lanczos method damps all of these components exponentially, thus guaranteeing the correctness of the solution. DOE

N92-19345# Columbia Univ., New York, NY.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Final Report, 1 Apr. 1988 - 31 Mar. 1991
George Flynn and Richard Osgood, Jr. 31 May 1991 11 p
(Contract DAAL03-88-C-0009)
(AD-A244425; ARO-25632.11-EL) Avail: NTIS HC/MF A03 CSCL 20/3

The technical program has continued to emphasize the fundamentals of optical techniques and electronic materials. The quantum statistics of squeezed light and fractal noise are examined. We continue to push the frontiers of coherent ultrashort-pulse spectroscopy by examining attosecond pulses in four-wave mixing experiments. Interfacial phenomena was studied in buried epitaxial insulator-semiconductor interfaces (with laser photoemission) and bimetal Schottky barriers in GaAs. Work on high pressure studies of II-VI superlattices has yielded information about stress and strain in these layered compounds. Direct infrared laser probing of chlorine atoms was implemented in the following of Cl atom concentrations in etching environments. Finally, a new program in packaging science has been formulated for next year's program. GRA

N92-19360# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. HF-Physik.
FOCUSED TWO-DIMENSIONAL RADAR IMAGING USING COHERENT TIME DOMAIN SIGNALS
Karl-Heinz Bethke Apr. 1991 72 p In GERMAN; ENGLISH summary Translation was announced as ESA-TT-1272
(DLR-FB-91-19; ISSN-0939-2963; ETN-92-90736) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 27 DM

A method for generating two-dimensional focused radar images of rotating objects is presented. While range resolution is performed in discrete range steps in real time by a coherent short pulse radar, the cross range resolution is generated offline, using the synthetic aperture principle via efficient Fast Fourier Transform (FFT) algorithms. The degradations resulting from the approximations of the image algorithm and from the migration effects of scattering centers through resolution cells are eliminated by an extended phase correction, and by a tracking procedure acting on the moving scattering centers. Experimental results demonstrate the capability of the image procedure presented. ESA

N92-19379*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PREDICTIVE ONBOARD FLOW CONTROL FOR PACKET SWITCHING SATELLITES
Eric A. Bobinsky Mar. 1992 10 p Proposed for presentation at the 14th International Communications Satellite Systems Conference, Washington, DC, 22 Mar. 1992; sponsored by AIAA
(NASA-TM-105566; E-6890; NAS 1.15:105566) Avail: NTIS HC/MF A02 CSCL 17B

We outline two alternate approaches to predicting the onset of congestion in a packet switching satellite, and argue that predictive, rather than reactive, flow control is necessary for the efficient operation of such a system. The first method discussed is based on standard, statistical techniques which are used to periodically calculate a probability of near-term congestion based on arrival rate statistics. If this probability exceeds a present threshold, the satellite would transmit a rate-reduction signal to all active ground stations. The second method discussed would utilize a neural network to periodically predict the occurrence of buffer overflow based on input data which would include, in addition to arrival rates, the distributions of packet lengths, source addresses, and destination addresses. Author

N92-19382# Centro Studi e Laboratori Telecomunicazioni, Turin (Italy).
[ACTIVITIES REPORT OF THE CENTRO STUDI E LABORATORI TELECOMUNICAZIONI: REPORTS AND BALANCES] Annual Report, 31 Dec. 1990 [CSELT RAPPORTO ANNUALE 1990: RELAZIONI E BILANCIO AL 31 DICEMBRE 1990]
May 1991 70 p In ITALIAN
(ETN-92-90836) Avail: NTIS HC/MF A04

The CSELT management report on structure and activities covers public and ISDN (Integrated Services Digital Network) networks, intelligence and service networks, mobile services, management of OSS (Operation Support Systems) and networks, high-speed networks and services, optical networks and systems, radio points and satellites, and duality and conformity tests. Management progress, investments, personnel, participation in European projects, and collaboration with Italian universities are

outlined. An analysis of income results and of the patrimonial and financial situations is given. Balances at 31 Dec. 1990 are shown. ESA

N92-19389# Harvard Univ., Cambridge, MA. Dept. of Psychology.
PERCEPTION AND THE TEMPORAL PROPERTIES OF SPEECH Annual Report, Jul. 1989 - Jul. 1991
Peter C. Gordon 6 Nov. 1991 46 p
(Grant AF-AFOSR-0461-89; AF Proj. 2313)
(AD-A243979; AFOSR-91-0993TR) Avail: NTIS HC/MF A03 CSCL 05/7

Four experiments addressing the role of attention in phonetic perception are reported. The first experiment shows that the relative importance of two cues to the voicing distinction changes when subjects must perform an arithmetic distractor task at the same time as identifying a speech stimulus. The voice onset time cue loses phonetic significance when subjects are distracted, while the F0 onset frequency cue does not. The second experiment shows a similar pattern for two cues to the distinction between the vowels /i/ (as in 'beat') and /I/ (as in 'bit'). Together these experiments indicate that careful attention to speech perception is necessary for strong acoustic cues to achieve their full phonetic impact, while weaker acoustic cues achieve their full phonetic impact without close attention. Experiment 3 shows that this pattern is obtained when the distractor task places little demand on verbal short term memory. Experiment 4 provides a large data set for testing formal models of the role of attention in speech perception. Attention is shown to influence the signal to noise ratio in phonetic encoding. This principle is instantiated in a network model in which the role of attention is to reduce noise in the phonetic encoding of acoustic cues. Implications of this work for understanding speech perception and general theories of the role of attention in perception are discussed. GRA

N92-19451# International Centre for Theoretical Physics, Trieste (Italy).
P VIOLATING MAGNETIC MONOPOLE INFLUENCE ON THE BEHAVIOUR OF THE ATOM-LIKE SYSTEM IN THE EXTERNAL FIELDS
Ya. M. Shnir, E. A. Tolkachev, and L. M. Tomilchik (Akademiya Nauk BSSR, Minsk.) Jul. 1991 26 p Submitted for publication
(DE92-609051; IC-91/144) Avail: NTIS HC/MF A03

The properties of the bound system charge-dyon (so called 'dyonium') in the external electromagnetic field are considered. It is shown that the spectrum of dipole radiation of the dyonium contains direct information on the spatial parity violation in the electrodynamics with magnetic charge. It is found that the P noninvariance of this system leads to essential differences between the Stark and Zeeman effects for a hydrogen atom and those for dyogen. The photoionization process of the hydrogen-like atom in the field of the magnetic charge is calculated. It is shown that the corresponding angular distribution of the photoelectron has the essentially asymmetry due to the P parity breaking. DOE

N92-19478# Ballistic Research Labs., Aberdeen Proving Ground, MD.
STRUCTURAL DESIGN ISSUES FOR ELECTROMAGNETIC PROJECTILES Final Report, 1 May 1989 - 1 May 1990
K. A. Bannister, L. Burton, and W. H. Drysdale Dec. 1991 42 p
(DA Proj. 1L1-62618-AH-80)
(AD-A243851; BRL-TR-3299) Avail: NTIS HC/MF A03 CSCL 19/1

Many structural design issues in electromagnetic (EM) launch of projectiles can be analyzed by techniques used for conventional powder gun-launched projectiles. We give general design guidance and discuss analysis methods for assessment and management of EM launch loads. This information is distilled from design and analysis experience on saboted-rod kinetic energy (KE) projectiles to survive conventional launch environments. While the physics of EM launcher systems differ radically from conventional systems, many of the barrel/projectile interactions problems are similar to those encountered in conventional systems over the past 15 years. Knowledge on solving conventional KE projectile problems may then benefit the EM community. In-bore loading characteristics of concern are: (1) large axial forces; (2) rapid initial rise times and 'jogs' in loading due to EM current changes; and (3) lateral loads. Transient finite element analyses of a 120-mm KE round subjected to EM and conventional loadings are presented. These help illustrate dramatic response differences between the two kinds of propulsion environments. GRA

N92-19510# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ELECTROMAGNETIC SCATTERING FROM DIELECTRIC PYRAMIDAL TIPS M.S. Thesis
Albert D. Tyson, IV Dec. 1991 122 p
(AD-A243877; AFIT/GE/ENG/91D-56) Avail: NTIS HC/MF A06 CSCL 20/14

This thesis investigated the electromagnetic scattering from conducting, lossless dielectric, and lossy dielectric (absorber) pyramids. The backscatter from pyramids was measured and a time gate was applied to isolate the scattering from the tips. The measured results were compared to predictions from an approximate Uniform Theory of Diffraction (UTD) solution for scattering by a dielectric corner. The accuracy of the corner diffraction solution was found to be dependent on the polarization of the incident electric field. The accuracy of the UTD solution was also dependent on the aspect angle to the pyramid: the UTD solution gave a nominally correct answer within 25 degrees of nose-on incidence; at other angles the accuracy was better or worse depending on field polarization. The accuracy of the corner diffraction solution when applied to a dielectric was primarily dependent on the tip angle of the pyramid, with more acute angles giving the least accurate results. At incidence angles near nose-on to absorber pyramids, scattering from internal inhomogeneities was the dominant scattering mechanism. At incidence angles away from nose-on, the UTD solution provided reasonably accurate results. The approximate UTD dielectric corner solution was found to be accurate for many engineering applications. Author (GRA)

N92-19557# Sandia National Labs., Albuquerque, NM.
EXPANDED COAXIAL TRANSMISSION CELLS FOR ELECTROMAGNETIC TESTING
R. W. Cernosek Oct. 1991 234 p
(Contract DE-AC04-76DP-00789)
(DE92-004474; SAND-91-0768) Avail: NTIS HC/MF A11

Coaxial transmission cells have been developed for testing optical fiber current sensors. Three of these cells are airlines that provide transverse electromagnetic mode operation to 1.0, 2.3, and 13.7 GHz. Standing wave ratios are less than 1.5 for the unloaded airlines over their given frequency ranges. Solid and liquid dielectric coaxial cells use materials with high relative permittivities, greater than 9.1. A ceramic test cell has a useful frequency range to 2.5 GHz; the liquid cells, filled with propanol, methanol, or water, are good to (approximately) 500 MHz. The properties of the liquid cells are described using a model of a multilayer coaxial dielectric system with complex relative permittivities. DOE

N92-19700*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
REAL-TIME DEMONSTRATION HARDWARE FOR ENHANCED DPCM VIDEO COMPRESSION ALGORITHM
Thomas P. Bizon, Wayne A. Whyte, Jr., and Vincent R. Marcopoli (Case Western Reserve Univ., Cleveland, OH.) 1992 17 p Proposed for presentation at the Data Compression Conference (DCC 1992), Snowbird, UT, 24-26 Mar. 1992; sponsored by IEEE
(NASA-TM-105616; E-6954; NAS 1.15:105616) Avail: NTIS HC/MF A03 CSCL 17B

The lack of available wideband digital links as well as the complexity of implementation of bandwidth efficient digital video CODECs (encoder/decoder) has worked to keep the cost of digital television transmission too high to compete with analog methods.

Terrestrial and satellite video service providers, however, are now recognizing the potential gains that digital video compression offers and are proposing to incorporate compression systems to increase the number of available program channels. NASA is similarly recognizing the benefits of and trend toward digital video compression techniques for transmission of high quality video from space and therefore, has developed a digital television bandwidth compression algorithm to process standard National Television Systems Committee (NTSC) composite color television signals. The algorithm is based on differential pulse code modulation (DPCM), but additionally utilizes a non-adaptive predictor, non-uniform quantizer and multilevel Huffman coder to reduce the data rate substantially below that achievable with straight DPCM. The non-adaptive predictor and multilevel Huffman coder combine to set this technique apart from other DPCM encoding algorithms. All processing is done on a intra-field basis to prevent motion degradation and minimize hardware complexity. Computer simulations have shown the algorithm will produce broadcast quality reconstructed video at an average transmission rate of 1.8 bits/pixel. Hardware implementation of the DPCM circuit, non-adaptive predictor and non-uniform quantizer has been completed, providing realtime demonstration of the image quality at full video rates. Video sampling/reconstruction circuits have also been constructed to accomplish the analog video processing necessary for the real-time demonstration. Performance results for the completed hardware compare favorably with simulation results. Hardware implementation of the multilevel Huffman encoder/decoder is currently under development along with implementation of a buffer control algorithm to accommodate the variable data rate output of the multilevel Huffman encoder. A video CODEC of this type could be used to compress NTSC color television signals where high quality reconstruction is desirable (e.g., Space Station video transmission, transmission direct-to-the-home via direct broadcast satellite systems or cable television distribution to system headends and direct-to-the-home). Author

N92-19703# Onsala Space Observatory (Sweden).
NEW MILLIMETRIC VLBI RESULTS
22 Oct. 1991 12 p Presented at the Extra-Galactic Radio Sources-from Beam to Jet held in Paris, Jul. 1991; and VLBI Observation of Quasars 3C345 and CTA102 at 18 CM Wavelength, presented at the Physics of Active Galactic Nuclei, Heidelberg, Fed. Republic of Germany, Jun. 1991
(PB92-124916) Avail: NTIS HC/MF A03 CSCL 17B

Very long base interferometry (VLBI) observations at 100 GHz started as early as 1981, but 1988 was the first epoch aimed for full hybrid mapping. At the same time, a new data reduction technique was developed to fully handle the new data. Since 1989, three epoches have been observed, in March 1988, March 1989, and April 1990. These observations involved telescopes in Sweden, Japan, and the U.S. The epoch of 1990 also for the first time in VLBI included the SEST telescope in Chile, and the resolution in the north-south direction was drastically improved. Observations with VLBI at mm wavelength is currently the only possibility to make images of the cores of active galactic nuclei. Such observations can give us direct insight into the core areas on size scales less than the broad line region and close to that of the accretion disc. GRA

N92-19724# International Centre for Theoretical Physics, Trieste (Italy).
INTERFERENCE IN A THICK PLATE AT LARGE ANGLE OF INCIDENCE
M. T. Tavassoli and F. ShahShehany (Alzahra Univ., Tehran, Iran) Jun. 1991 15 p
(DE92-609182; LAMP-91/4) Avail: NTIS HC/MF A03

A new approach to the interference in a plane parallel plate is introduced which is valid for any angle of incidence and any thickness. It is shown that the interference in a plate can be interpreted as the interference in a double-slit and the corresponding parameters are derived. It is also shown that for a particular angle of incidence, which depends only on the refractive index, the interfringes are minimum. It is proved theoretically and verified experimentally that the interference around this particular angle of incidence has several exploitable features which include: (1) In thick plates large numbers of equidistant fringes are formed which are very adequate for producing interference gratings; (2) It provides, in comparison to the conventional interferometric methods, an easier and more accurate means for direct measurement of wave length; and (3) Multiple-beam interference at this particular angle improve the accuracy of the measurement of the fine structures of the atomic spectra, compared to other interferometric methods. DOE

N92-19736*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FINITE DIFFERENCE TIME DOMAIN ELECTROMAGNETIC SCATTERING FROM FREQUENCY-DEPENDENT LOSSY MATERIALS Final Report, 1 Mar. 1990 - 30 Jun. 1991
Raymond J. Luebbers and John H. Beggs Jul. 1991 279 p (Grant NAG2-648)
(NASA-CR-189863; NAS 1.26:189863) Avail: NTIS HC/MF A13 CSCL 20N

Four different FDTD computer codes and companion Radar Cross Section (RCS) conversion codes on magnetic media are submitted. A single three dimensional dispersive FDTD code for both dispersive dielectric and magnetic materials was developed, along with a user's manual. The extension of FDTD to more complicated materials was made. The code is efficient and is capable of modeling interesting radar targets using a modest computer workstation platform. RCS results for two different plate geometries are reported. The FDTD method was also extended to computing far zone time domain results in two dimensions. Also the capability to model nonlinear materials was incorporated into FDTD and validated. For individual titles, see N92-19737 through N92-19749.

N92-19737*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR THREE DIMENSIONAL FDTD VERSION A CODE FOR SCATTERING FROM FREQUENCY-INDEPENDENT DIELECTRIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 22 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Finite Difference Time Domain Electromagnetic Scattering Code Version A is a three dimensional numerical electromagnetic scattering code based upon the Finite Difference Time Domain Technique (FDTD). This manual provides a description of the code and corresponding results for the default scattering problem. In addition to the description, the operation, resource requirements, version A code capabilities, a description of each subroutine, a brief discussion of the radar cross section computations, and a discussion of the scattering results. Author

N92-19738*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR THREE DIMENSIONAL FDTD VERSION B CODE FOR SCATTERING FROM FREQUENCY-DEPENDENT DIELECTRIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 31 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Penn State Finite Difference Time Domain Electromagnetic Scattering Code Version B is a three dimensional numerical electromagnetic scattering code based upon the Finite Difference Time Domain Technique (FDTD). The supplied version of the code is one version of our current three dimensional FDTD code set. This manual provides a description of the code and corresponding results for several scattering problems. The manual is organized into fourteen sections: introduction, description of the FDTD

method, operation, resource requirements, Version B code capabilities, a brief description of the default scattering geometry, a brief description of each subroutine, a description of the include file (COMMONB.FOR), a section briefly discussing Radar Cross Section (RCS) computations, a section discussing some scattering results, a sample problem setup section, a new problem checklist, references and figure titles. Author

N92-19739*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR THREE DIMENSIONAL FDTD VERSION C CODE FOR SCATTERING FROM FREQUENCY-INDEPENDENT DIELECTRIC AND MAGNETIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 26 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Penn State Finite Difference Time Domain Electromagnetic Scattering Code Version C is a three dimensional numerical electromagnetic scattering code based upon the Finite Difference Time Domain Technique (FDTD). The supplied version of the code is one version of our current three dimensional FDTD code set. This manual provides a description of the code and corresponding results for several scattering problems. The manual is organized into fourteen sections: introduction, description of the FDTD method, operation, resource requirements, Version C code capabilities, a brief description of the default scattering geometry, a brief description of each subroutine, a description of the include file (COMMONC.FOR), a section briefly discussing Radar Cross Section (RCS) computations, a section discussing some scattering results, a sample problem setup section, a new problem checklist, references and figure titles. Author

N92-19740*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR THREE DIMENSIONAL FDTD VERSION D CODE FOR SCATTERING FROM FREQUENCY-DEPENDENT DIELECTRIC AND MAGNETIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 45 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Penn State Finite Difference Time Domain Electromagnetic Scattering Code Version D is a three dimensional numerical electromagnetic scattering code based upon the Finite Difference Time Domain Technique (FDTD). The supplied version of the code is one version of our current three dimensional FDTD code set. This manual provides a description of the code and corresponding results for several scattering problems. The manual is organized into fourteen sections: introduction, description of the FDTD method, operation, resource requirements, Version D code capabilities, a brief description of the default scattering geometry, a brief description of each subroutine, a description of the include file (COMMOND.FOR), a section briefly discussing Radar Cross Section (RCS) computations, a section discussing some scattering results, a sample problem setup section, a new problem checklist, references and figure titles. Author

N92-19741*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR TWO DIMENSIONAL FDTD VERSION TEA AND TMA CODES FOR SCATTERING FROM FREQUENCY-INDEPENDENT DIELECTIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 19 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Penn State Finite Difference Time Domain Electromagnetic Scattering Code Versions TEA and TMA are two dimensional numerical electromagnetic scattering codes based upon the Finite Difference Time Domain Technique (FDTD) first proposed by Yee in 1966. The supplied version of the codes are two versions of our current two dimensional FDTD code set. This manual provides a description of the codes and corresponding results for the default scattering problem. The manual is organized into eleven sections: introduction, Version TEA and TMA code capabilities, a brief description of the default scattering geometry, a brief description of each subroutine, a description of the include files (TEACOM.FOR TMACOM.FOR), a section briefly discussing scattering width computations, a section discussing the scattering results, a sample problem set section, a new problem checklist, references and figure titles. Author

N92-19742*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
A TWO-DIMENSIONAL TIME DOMAIN NEAR ZONE TO FAR ZONE TRANSFORMATION
Raymond J. Luebbers, Deirdre Ryan, John H. Beggs, and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 p 24 (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

In a previous paper, a time domain transformation useful for extrapolating 3-D near zone finite difference time domain (FDTD) results to the far zone was presented. In this paper, the corresponding 2-D transform is outlined. While the 3-D transformation produced a physically observable far zone time domain field, this is not convenient to do directly in 2-D, since a convolution would be required. However, a representative 2-D far zone time domain result can be obtained directly. This result can then be transformed to the frequency domain using a Fast Fourier Transform, corrected with a simple multiplicative factor, and used, for example, to calculate the complex wideband scattering width of a target. If an actual time domain far zone result is required it can be obtained by inverse Fourier transform of the final frequency domain result. Author

N92-19743*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FINITE DIFFERENCE TIME DOMAIN IMPLEMENTATION OF SURFACE IMPEDANCE BOUNDARY CONDITIONS
John H. Beggs, Raymond J. Luebbers, Kane S. Yee (Lockheed Missiles and Space Co., Sunnyvale, CA.), and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 30 p Revised (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

Surface impedance boundary conditions are employed to reduce the solution volume during the analysis of scattering from lossy dielectric objects. In a finite difference solution, they also can be utilized to avoid using small cells, made necessary by shorter wavelengths in conducting media throughout the solution volume. The standard approach is to approximate the surface impedance over a very small bandwidth by its value at the center frequency, and then use that result in the boundary condition. Two implementations of the surface impedance boundary condition are presented. One implementation is a constant surface impedance boundary condition and the other is a dispersive surface impedance boundary condition that is applicable over a very large frequency bandwidth and over a large range of conductivities. Frequency domain results are presented in one dimension for two conductivity values and are compared with exact results. Scattering width results from an infinite square cylinder are presented as a 2-D demonstration. Extensions to 3-D should be straightforward. Author

N92-19744*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
WIDEBAND FINITE DIFFERENCE TIME DOMAIN IMPLEMENTATION OF SURFACE IMPEDANCE BOUNDARY CONDITIONS FOR GOOD CONDUCTORS
John H. Beggs, Raymond J. Luebbers, Karl S. Kunz, and Kane S.

Yee (Lockheed Missiles and Space Co., Sunnyvale, CA.) *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 4 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

Surface impedance boundary conditions are employed to reduce the solution volume during the analysis of scattering from lossy dielectric objects. In a finite difference solution, they also can be utilized to avoid using small cells, made necessary by shorter wavelengths in conducting media, throughout the solution volume. A 1-D implementation for a surface impedance boundary condition for good conductors in the Finite Difference Time Domain (FDTD) technique. Author

N92-19745*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
TIME DOMAIN SCATTERING AND RADAR CROSS SECTION CALCULATIONS FOR A THIN, COATED PERFECTLY CONDUCTING PLATE
Raymond J. Luebbers and John H. Beggs *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 10 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

Radar cross section (RCS) calculations for flat, perfectly conducting plates are readily available through the use of conventional frequency domain techniques such as the Method of Moments (MOM). However, if the plate is covered with a dielectric material that is relatively thick in comparison with the wavelength in the material, these frequency domain techniques become increasingly difficult to apply. We present the application of the Finite Difference Time Domain (FDTD) Technique to the problem of electromagnetic scattering and RCS calculations from a thin, perfectly conducting plate that is coated with a thick layer of lossless dielectric material. Both time domain and RCS calculations are presented and disclosed. Author

N92-19746*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
CONICAL CUT RADAR CROSS SECTION CALCULATIONS FOR A THIN, PERFECTLY CONDUCTING PLATE
Raymond J. Luebbers and John H. Beggs *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 13 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

Radar Cross Section (RCS) calculations for flat, perfectly conducting plates are readily available through the use of conventional frequency domain techniques such as the Method of Moments. However, if time domain scattering or wideband frequency domain results are desired, then the Finite Difference Time Domain (FDTD) technique is a suitable choice. In this paper, we present the application of the Finite Difference Time Domain (FDTD) technique to the problem of electromagnetic scattering and RCS calculations from a thin, perfectly conducting plate for a conical cut in the scattering angle phi. RCS calculations versus angle phi will be presented and discussed. Author

N92-19747*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FDTD MODELING OF THIN IMPEDANCE SHEETS
Raymond J. Luebbers and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 17 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

Thin sheets of resistive or dielectric material are commonly encountered in radar cross section calculations. Analysis of such sheets is simplified by using sheet impedances. In this paper it is shown that sheet impedances can be modeled easily and accurately using Finite Difference Time Domain (FDTD) methods. Author

N92-19748*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FINITE DIFFERENCE TIME DOMAIN CALCULATION OF TRANSIENTS IN ANTENNAS WITH NONLINEAR LOADS
Raymond J. Luebbers, John H. Beggs, Karl S. Kunz, and Kent Chamberlin (New Hampshire Univ., Durham.) *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 16 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

In this paper transient fields for antennas with more general geometries are calculated directly using Finite Difference Time Domain methods. In each FDTD cell which contains a nonlinear load, a nonlinear equation is solved at each time step. As a test case the transient current in a long dipole antenna with a nonlinear load excited by a pulsed plane wave is computed using this approach. The results agree well with both calculated and measured results previously published. The approach given here extends the applicability of the FDTD method to problems involving scattering from targets including nonlinear loads and materials, and to coupling between antennas containing nonlinear loads. It may also be extended to propagation through nonlinear materials. Author

N92-19749*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FINITE DIFFERENCE TIME DOMAIN CALCULATIONS OF ANTENNA MUTUAL COUPLING
Raymond J. Luebbers and Karl S. Kunz *In its* Finite Difference Time Domain Electromagnetic Scattering from Frequency-Dependent Lossy Materials Jul. 1991 15 p (For primary document see N92-19736 10-32)
Avail: NTIS HC/MF A13 CSCL 20N

The Finite Difference Time Domain (FDTD) technique has been applied to a wide variety of electromagnetic analysis problems, including shielding and scattering. However, the method has not been extensively applied to antennas. In this short paper calculations of self and mutual admittances between wire antennas are made using FDTD and compared with results obtained using the Method of Moments. The agreement is quite good, indicating the possibilities for FDTD application to antenna impedance and coupling. Author

N92-19764# Electroimpact, Inc., Seattle, WA.
SUPPRESSION OF RADIATING HARMONICS ELECTRO-IMPULSE DEICING (EIDI) SYSTEMS
Peter Zieve, James Ng, and Robert Fiedberg Oct. 1991 33 p (Contract DTFA03-89-P-00692)
(DOT/FAA/CT-TN90/33) Avail: NTIS HC/MF A03

The electromagnetic compatibility (EMC) of two different configurations of electromagnetic deicing systems is discussed. Both Electro-Impulse Deicing (EIDI) and Eddy Current Repulsion Deicing Strip (EDS) are investigated. With EIDI, rigid coils are mounted behind the wing; while with EDS, the impulse coils are built thin and flexible with printed circuit board technology. An important consideration in the certification of electromagnetic impulse deicing systems is electromagnetic compatibility (EMC). When the capacitor bank discharges, a large current pulse travels down a transmission line to the coil. The coil is one source of radiation. Another source is the cabling and connections to the coil. In work conducted for the FAA in 1988, it was found that excessive electromagnetic emissions resulted from the operation of a Low Voltage Electro-Impulse Deicer (LVEID) in conjunction with a composite wing. The goal of this project was to investigate and develop techniques for controlling emissions without the benefit of shielding. In this study it was determined that both EIDI and EDS could be brought within the RTCA/DO-160B standards through proper shielding and termination of the pulse power cable. An alternative topology of EDS with the impulse coil on the wing exterior surface did not meet the standard. Author

N92-19785# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
FREQUENCY STANDARDS FOR COMMUNICATIONS
Samuel R. Stein (Timing Solutions Corp., Boulder, CO.) and John R. Vig Oct. 1991 75 p Revised Supersedes AD-A231990
(DA Proj. 1L1-62705-AH-94)
(AD-A243211; SLCET-TR-91-2-Rev-1; AD-A231990) Avail: NTIS HC/MF A04 CSCL 14/2

The fundamentals of quartz and atomic frequency standards are reviewed. The subjects discussed include: crystal resonators and oscillators, atomic oscillators, oscillator types, and the characteristic and limitations of temperature-compensated crystal oscillators (TCXO), oven-controlled crystal oscillators (OCXO), rubidium frequency standards, cesium beam frequency standards and hydrogen masers. The oscillator instabilities discussed include: aging, noise, frequency vs. temperature, warmup, acceleration effects, magnetic field effects, atmospheric pressure effects, radiation effects, and interactions among the various effects. Guidelines are provided for oscillator comparison and selection. Discussions of time transfer techniques and specifications are also included, as are references and suggestions for further reading.
Author (GRA)

N92-19922*# Universities Space Research Association, Huntsville, AL.
OBSERVATION AND NUMERICAL SIMULATION OF A CONVECTIVE INITIATION DURING COHMEX
J. Aaron Song and Michael L. Kaplan 22 Jul. 1991 74 p Prepared in cooperation with Mesoscale Environmental Simulations and Operations, Inc., Troy, NY
(Contract NAS8-37141)
(NASA-CR-184285; NAS 1.26:184285) Avail: NTIS HC/MF A04 CSCL 20N

Under a synoptically undisturbed condition, a dual-peak convective lifecycle was observed with the COoperative Huntsville Meteorological EXperiment (COHMEX) observational network over a 24-hour period. The lifecycle included a multicell storm, which lasted about 6 hours, produced a peak rainrate exceeding 100 mm/hr, and initiated a downstream mesoscale convective system. The 24-hour accumulated rainfall of this event was the largest during the entire COHMEX. The downstream mesoscale convective system, unfortunately, was difficult to investigate quantitatively due to the lack of mesoscale observations. The dataset collected near the time of the multicell storm evolution, including its initiation, was one of the best datasets of COHMEX. In this study, the initiation of this multicell storm is chosen as the target of the numerical simulations.
D.R.D.

N92-19992*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MICROWAVE BEAM POWER TRANSMISSION AT AN ARBITRARY RANGE
L. R. Pinero, J. L. Christian, Jr., and R. J. Acosta Feb. 1992 18 p
(NASA-TM-105424; E-6841; NAS 1.15:105424) Avail: NTIS HC/MF A03 CSCL 20N

The power transfer efficiency between two circular apertures at an arbitrary range is obtained numerically. The apertures can have generally different sizes and arbitrary taper illuminations. The effects of distance and taper illumination on the transmission efficiency are investigated for equal size apertures. The result shows that microwave beam power is more effective at close ranges, namely distances less than 2D(exp 2)/lambda. Also shown was the power transfer efficiency increase with taper illumination for close range distances. A computer program was developed for calculating the power transfer efficiency at an arbitrary range.
Author

N92-20016# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Technology Div.
BIBLIOGRAPHY OF THE NIST ELECTROMAGNETIC FIELDS DIVISION PUBLICATIONS
R. M. Lyons and K. A. Gibson Aug. 1991 108 p
(PB92-116367; NISTIR-3973) Avail: NTIS HC/MF A06 CSCL 20N

The bibliography lists the publications by the staff of the Electromagnetic Fields Division (EFD) of the National Institute of Standards and Technology for the period Jan. 1970 - Jul. 1991. It supersedes NISTIR-3945, which listed the publications of the EFD from Jan. 1970 through Jul. 1990. Selected earlier publications from the EFD's predecessor organizations are included. The major topics covered include: antennas, dielectric measurements, electromagnetic interference, microwave metrology, microwave power, impedance, attenuation, near-field antenna measurements, noise, nonionizing radiation, radiation hazards, standards, time domain, and waveform metrology.
GRA

N92-20017# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Technology Div.
METROLOGY FOR ELECTROMAGNETIC TECHNOLOGY: A BIBLIOGRAPHY OF NIST PUBLICATIONS
M. E. DeWeese Aug. 1991 69 p
(PB92-116375; NISTIR-3972) Avail: NTIS HC/MF A04 CSCL 20N

The bibliography lists the publications of the personnel of the Electromagnetic Technology Division of the National Institute of Standards and Technology during the period from Jan. 1970 through publication of the report. A few earlier references that are directly related to the present work of the Division are also included. Major topics covered include: cryoelectronics, electromagnetic metrology, lasers, optical fibers, and superconducting materials.
GRA

N92-20032*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUBBAND CODING FOR IMAGE DATA ARCHIVING
D. Glover and S. C. Kwatra (Toledo Univ., OH.) 1992 15 p Proposed for presentation at the Data Compression Conference, Snowbird, UT, 24-27 Mar. 1992; sponsored by IEEE
(NASA-TM-105407; E-6722; NAS 1.15:105407) Avail: NTIS HC/MF A03 CSCL 17B

The use of subband coding on image data is discussed. An overview of subband coding is given. Advantages of subbanding for browsing and progressive resolution are presented. Implementations for lossless and lossy coding are discussed. Algorithm considerations and simple implementations of subband are given.
Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N92-19032# Rochester Univ., NY. Inst. of Optics.
ELECTRONIC IMAGING: ROCHESTER IMAGING CONSORTIUM, ABSTRACTS OF RESEARCH TOPICS REPORTED AT THE ANNUAL MEETING OF THE OPTICAL SOCIETY OF AMERICA Final Briefing Report
Nicholas George Nov. 1991 98 p Meeting held in San Jose, CA, 3-8 Nov. 1991
(Contract DAAL03-86-K-0173)
(AD-A244319; ARO-24626.236-PH-U1R) Avail: NTIS HC/MF A05 CSCL 09/1

Reports are presented from the conference. Some areas of discussion are as follows: Facial Recognition Using Image and Transform Representations; Particulate Sorting Using Matched Filters; Recovery of Particulate Size Distributions by Inversion of the Optical Transform Pattern; Beam Splitter Cube for White Light Interferometry; Backscatter from a Tilted Rough Disc; and Image Deblurring for Multiple Point Impulse Responses.
GRA

N92-19070# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
HIGH-POWER MICROWAVE BREAKDOWN OF DIELECTRIC INTERFACES Final Report, 15 Jan. 1988 - 14 Apr. 1991
M. Kristiansen, L. Hatfield, Mark Crawford, and Steve Calico 11 Nov. 1991 33 p
(Grant AF-AFOSR-0102-88; AF Proj. 2301)
(AD-A243861; AFOSR-91-1000TR) Avail: NTIS HC/MF A03 CSCL 20/3

The goal of this project is the study of the electrical breakdown, due to microwaves, which occurs on the surface of vacuum/atmosphere interfaces. This is a final report for AFOSR Grant No. 88-0102, that began in January, 1988. This report, however, will concentrate on the results since the last annual report, dated September 3, 1990. In the past year, the system was fired over 300 times while investigating the breakdown process. Window materials, coatings, surface textures, shapes, and ambient gases were all varied and the results recorded. The diagnostics system was timed to provide temporal correlation between the different signals. Using the particle-in-cell code (MAGIC), overall microwave power and field information has been calculated for the various window configurations. The bulk of these shots were taken using about one-half of the available power from the machine. Recently, the machine was fired several times at near maximum values. Weak points in the machine design were discovered and corrected. Research is continuing, under AFOSR grant No. 91-0260, using the higher power levels from the machine. GRA

N92-19099# Arizona Univ., Tucson.
SURVEYING WITH CHARGE COUPLED DEVICES Final Report, Jul. 1986 - Apr. 1989
Thomas Gehrels Oct. 1991 65 p
(Contract F30602-86-C-0139)
(AD-A244065; RL-TR-91-261) Avail: NTIS HC/MF A04 CSCL 09/1

The 0.91-m Spacewatch Telescope of the Steward Observatory of the University of Arizona on Kitt Peak is dedicated to scanning with charge-coupled devices (CCD's) during the dark half of the month. We explored six modes of using CCD's for searches of gamma ray bursters, debris in geosynchronous space, satellites of asteroids, brown dwarf stars, the tenth planet, comets, cometesimals, and various types of asteroids. In the process, we gained experience with cosmic rays and artifacts in CCD observations. Each of these topics is described. I especially note that the existence of cometesimals has not been confirmed by the Spacewatch Telescope. This paper describes a new discipline in astrophysics, 'scannerscopy', of surveying with a CCD rather than with photography at a Schmidt telescope. It uses the CCD in scanning rather than in sequencing of stare exposures as is done at most observatories. Usually we turn the drive off, but the scanning can be done with the telescope slewing. In any case, the motion on the sky is precisely followed by slaving the charge transfer of the CCD to the drift rate of the image, while the CCD is read out continuously during the observing. Our primary application of CCD-scanning is on moving objects such as comets and asteroids. We also do routine astrometry with CCD's, in a transit method, and this yields a precision of better than +/- 0.7 arcsecs. GRA

N92-19132# Texas Univ. at Dallas, Richardson. Center for Quantum Electronics.
THE DEMONSTRATION OF THE FEASIBILITY OF THE TUNING AND STIMULATION OF NUCLEAR RADIATION Final Report, 1 Nov. 1988 - 31 Oct. 1991
Carl B. Collins 31 Oct. 1991 48 p
(Contract N00014-89-J-1042)
(AD-A243842) Avail: NTIS HC/MF A03 CSCL 09/3

This project concerns the demonstration of the feasibility of the tuning and perhaps even stimulation of nuclear radiation. Theory has indicated that anti-Stokes Raman upconversion of intense but conventional long wavelength sources of radiation produced by scattering from isomeric states of nuclear excitation could lead to significant sources of tunable Gamma-radiation characterized by the natural Mossbauer widths of the lines. This would result in lines with sub-Angstrom wavelengths and widths of a few MHz. Whether or not these processes can reach threshold depends upon the resolution of basic issues lying in an interdisciplinary region between quantum electronics and nuclear physics that have not been previously addressed. It was the purpose of this work to study these issues experimentally. The overall problem being addressed is a broad one that naturally divides into three lines: (1) Coupling pump power into a nucleus, (2) Extracting nuclear excitation with a radiation field, and (3) Insuring material survival. Such a perspective is beyond the scope of a single project and only the second line has been addressed by the work supported by this grant. GRA

N92-19134# Stanford Univ., CA. Lab. of Physics.
SUBPICOSECOND ELECTROOPTIC SAMPLING AND DISTRIBUTED NONLINEAR ELECTRONICS Annual Report, 1 Sep. 1990 - 31 Aug. 1991
David M. Bloom, K. D. Li, J. T. Thackara, and M. T. Kauffman 30 Oct. 1991 17 p
(Contract F49620-88-C-0103)
(AD-A243845; AFOSR-91-0970TR) Avail: NTIS HC/MF A03 CSCL 09/1

Improvements made to the electro-optic sampling system have been instrumental to the demonstration of world record performance of an integrated photodiode/electrical sampler. Measured, under-convolved time response of the circuit was 1.8ps, corresponding to an electrical 3dB bandwidth of 200GHz. To measure such a short time response, the pulse width of the electro-optic sampling system was also used to make the first measurements of broadband electro-optic response of organic polymers. The use of these polymers, as well as erbium doped fiber optical amplifiers, to increase the utility of electro-optic sampling techniques has been investigated. Author (GRA)

N92-19171# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
QUANTUM 1/F NOISE IN SOLID-STATE DEVICES IN PARTICULAR Hg(1-x)Cd(x)Te N(+)-p DIODES Final Report
A. D. VanRheenen and P. H. Handel Aug. 1991 89 p
(Contract DAAL03-89-K-0009)
(AD-A244349; ARO-26417.13-EL) Avail: NTIS HC/MF A05 CSCL 09/1

Spectral intensity measurements of current fluctuations were investigated in the following solid state devices: mercury cadmium telluride diodes, AlGaAs/GaAs resonant tunneling diodes, InGaAs/Indium phosphide diodes, silicon bipolar transistors, AlaGaAs/GaAs heterojunction bipolar transistors, and silicon junction field effect transistors. The measurements were taken in the frequency range from 1 Hz to 100 kHz under different bias conditions and in the temperature range from 78 to 400 K. In addition, progress was made on the theoretical aspects of quantum 1/f noise. GRA

N92-19186# Georgia Inst. of Tech., Atlanta.
RF PLASMA AEROSOL DEPOSITION OF SUPERCONDUCTIVE YBACUO FILMS AT ATMOSPHERIC PRESSURE Final Technical Report
R. L. Snyder and X. W. Wang Nov. 1991 20 p
(Contract F30602-88-D-0025)
(AD-A244053; RL-TR-91-294) Avail: NTIS HC/MF A03 CSCL 09/1

Superconducting films were produced by a radio frequency (RF) plasma aerosol evaporation technique at atmospheric pressure without post-annealing. Aqueous solutions containing Y, Ba, and Cu were generated as an aerosol which was then injected into the plasma region. The ionized species were deposited onto substrates outside of both the plasma and flame regions. The substrate temperature was 400 to 600 C. The deposition rate is 0.01 to 100 microns/(min sq cm), and the film thickness is 1 to 200 microns. For an as deposited film on a single crystalline MgO substrate (100) with substrate temperature of 600 C, the onset temperature of the superconducting transition is 100 K, with a

transition width (10 to 90 pct.) of 3 K, and zero resistance at 93 K. An optimum substrate temperature for this technique is discussed. The as deposited films are compared with other post-annealed films (850 C, 1 hour). Since this technique does not require a vacuum environment it has potential for large scale production of thin films. GRA

N92-19205# Columbia Univ., New York, NY. Dept. of Electrical Engineering.
OPTOELECTRONICS FOR OPTICALLY CONTROLLED PHASED-ARRAY SYSTEMS Final Report, Mar. - Nov. 1990
Kam Y. Lau Nov. 1991 93 p
(Contract F19628-90-K-0017)
(AD-A244402; RL-TR-91-288) Avail: NTIS HC/MF A05 CSCL 09/5

This work is concerned with removing some of the major obstacles in practical application of fiber-optic techniques to microwave systems. Specifically, the problems addressed are that of RF throughput and noise figure of a microwave fiber-optic link. Due to the nature of the link and the characteristics of the optoelectronic devices, the RF throughput and noise figure of existing fiber-optic links are anywhere between unsatisfactory and unacceptable. Much of this originates from the intrinsic modulation efficiency of the optical source. It may be thought that this limitation is fundamental, since the devices in question already are approaching 100 percent quantum efficiency. Indeed, without new technological breakthroughs this problem may well be intractable. This report describes such a breakthrough, using a newly discovered effect in quantum well lasers known as gain-lever effect. Laser diodes constructed with gain-level incorporated into its structure shows efficiency enhancement of well over 40 dB, in addition to the fact that its intensity noise is actually reduced. Combining these two factors, and with proper impedance matching, it is shown that it is possible to construct a passive microwave fiber-optic link (defined as one without active electrical or optical amplification) exhibiting a RF throughput gain of up to 50 dB and a noise figure approaching 0 dB. Author (GRA)

N92-19212 Department of the Navy, Washington, DC.
NON-VOLATILE MEMORY CELL WITH FERROELECTRIC CAPACITOR HAVING LOGICALLY INACTIVE ELECTRODE Patent
Leonard J. Schwee, inventor (to Navy) 6 Aug. 1991 7 p
Filed 6 Mar. 1990
(AD-D015120; US-Patent-5,038,323; US-Patent-Appl-SN-489138; US-Patent-Class-365-145) Avail: US Patent and Trademark Office CSCL 09/1

The ferroelectric capacitor in each memory cell of an array has a logically inactive electrode plate maintained at a fixed voltage level and an opposed electrode plate coupled through a switching transistor, turned on by address signals, to a bit line through which the polarization of the capacitor is logically controlled to write and store binary logic data therein which is also readout through the same bit line at a different time during a logic restoring read operation. The ferroelectric material has sufficient conductivity to maintain the electrodes at nearly equal potentials. Author (GRA)

N92-19244# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
COHERENT COOPERATIVE RADIATION IN SOLIDS Final Report, 1 May 1990 - 31 Oct. 1991
Stephen C. Rand 30 Oct. 1991 43 p
(Contract F49620-88-C-0079)
(AD-A244056; AFOSR-91-0952TR) Avail: NTIS HC/MF A03 CSCL 09/3

Avalanche upconversion dynamics and associated nonlinear optical response was also reported for the first time in Tm:YALO crystals at room temperature. The avalanche mechanism involves a cooperative down conversion (cross relaxation) step and is a promising method of pumping rare earth lasers at entirely new (diode compatible) wavelengths, corresponding to excited state absorptions rather than ground state absorptions. Quantum theory describing the threshold for photo-darkening and the role of energy migration in avalanches was developed, and semi quantitative agreement obtained with preliminary measurements of nonlinear susceptibilities. Cooperative dynamics in general, and avalanche dynamics in particular, were shown to furnish a promising new mechanism not only for solid state lasers but for nonlinear optical interactions as well, opening the door to practical signal processing and switching applications exploiting the low intensity thresholds of avalanche processes. GRA

N92-19283# North Carolina State Univ., Raleigh.
FUSIBLE LINK TECHNOLOGY FOR POWER SEMICONDUCTOR DEVICES Final Report, 1 Oct. 1990 - 30 Sep. 1991
Prasad Venkatraman and B. J. Baliga Nov. 1991 23 p
(Contract DAAL03-90-G-0215)
(AD-A244110; ARO-28392.1-EL) Avail: NTIS HC/MF A03 CSCL 09/1

Theoretical and experimental studies were performed to investigate the feasibility of the formation of fusible links by using thin Aluminum films. The results of this research indicate that, by using the Aluminum films of 100 to 200 angstroms in thickness, it is possible to obtain links with fusing currents on the order of 10 milliamperes. These values may be acceptable for the fabrication of large area MOS-gated power devices. GRA

N92-19293# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
THE CURRENT MONITOR (901009) [STROOM-BEWAKER (901009)]
J. T. vanEs and J. C. Boes 1991 10 p In DUTCH
(DIGEL-1991-5; ETN-92-90813) Avail: NTIS HC/MF A02

A current monitor was designed and built to control the current of Delta power supplies. These power supplies are equipped with 'programming inputs' and 'monitoring outputs' which can be used for the remote setting and monitoring of output current and output voltage. The current monitor 901009 is a Eurocard containing a window discriminator. The window is fixed at + or - 2. If the current deviates more than + or - 2 from the preset valve, a contact is opened. The card also contains a potentiometer for the current setting of the power supply and a relay to reduce the current to zero. ESA

N92-19331# Ohio State Univ., Columbus. Electroscience Lab.
JOINT SERVICES ELECTRONICS PROGRAM Annual Report No. 14
Leon Peters, Jr. Nov. 1991 79 p
(Contract N00014-89-K-1007)
(AD-A244258; Rept-721563-3) Avail: NTIS HC/MF A05 CSCL 17/11

This report represents the fourteenth annual summary of The Ohio State University Joint Services Electronics Program (JSEP). The transfer of the compact range and target identification technology initiated under JSEP support for time domain studies continues to make large advances. Using other sources of support, design for a mini chamber has now been tested and performs beyond our expectations. Signals of the order of 80 dB below a square meter can be measured in this facility. This range is designed to study smaller targets at higher frequencies. Included in this report are: Diffraction Studies, IV Integral Equation Analysis of Exotic Media; Hybrid Studies; and VI Finite Element Analysis. GRA

N92-19373# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Technology Div.
FOLDED LAYER MULTIPLE-PASS CAVITY
Yuguang Xu, Qinyue Yu, Bo Lyu, Shou-Hau Chen, and Zhong-Hua Rong 19 Nov. 1991 13 p Transl. into ENGLISH from Zhongguo Jiguang (China), v. 17, no. 10, 1990 p 592-595
(AD-A244380; FTD-ID(RS)T-0689-91) Avail: NTIS HC/MF A03 CSCL 09/3

Structure of the folded layered multiple-pass cavity and its image quality are described, uniformity of scanning beam intensity at vertical direction in the middle position of the cavity is discussed,

and the high precision result of the reflectance cavity mirror is given. The folded layered multiple-pass cavity presented in this article has the following physical requirements: it must have a light beam with a scanning range of 200 x 800 mm and with a certain width; the scanning beam in a vertical direction must possess a certain amount of overlapping; the average nonuniformity of the beam intensity along the vertical direction of the central axis of the cavity is to be less than 50 percent. Therefore, it was required that the multiple-pass cavity not only have multiple reflections and good imaging quality of the scanning beam, but it must have an appropriate optical circuit track. GRA

N92-19390# University of Southern California, Los Angeles. Dept. of Electrical Engineering and Electrophysics.

HIGH POWER SOLID STATE SWITCHES Final Report, 15 Jan. 1988 - 14 Jul. 1991

Martin Gundersen 7 Nov. 1991 12 p

(Grant AF-AFOSR-0093-88)

(AD-A243980; AFOSR-91-0997TR) Avail: NTIS HC/MF A03 CSCL 20/6

We have successfully produced an optically triggered thyristor based in Gallium Arsenide, developed a model for breakdown, and are developing two related devices, including a Gallium Arsenide based static inductor thyristor. We are getting at the basic limitations of Gallium Arsenide for these applications, and are developing models for the physical processes that will determine device limitations. The previously supported gas phase work - resulting in the back-lighted thyratron (BLT) - has actually resulted in a very changed view of how switching can be accomplished, and this is impacting the design of important machines. The BLT is being studied internationally: in Japan for laser fusion and laser isotope separation. ITT has built a BLT that has switched 30 kA at 60 kV in testing at NSWC Dahlgren and the device is being commercialized by another American company. Versions of the switch are now being tested for excimer laser and other applications. Basically, the switch, which arose from pulse power physics studies at USC, can switch more current faster (higher di/dt), with less housekeeping, and with other advantageous properties. There are a large number of other new applications, include kinetic energy weapons, pulsed microwave sources and R.F. accelerators. GRA

N92-19406# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Groupe Composants et Circuits a Effet du Champ.

ELECTRICAL PROPERTIES OF METAL ULTRA-THIN ISOLANT SEMICONDUCTOR STRUCTURES Ph.D. Thesis - Toulouse Univ.

Khalil Kassmi 1991 185 p In FRENCH; ENGLISH summary

(LAAS-91257; ETN-92-90669) Avail: NTIS HC/MF A09

The phenomenon of electrical breakdown and ageing, which is a first cause of device failure, is investigated. The analysis of current and voltage characteristics of Metal Oxide Semiconductor (MOS) structures showed the presence of excess currents of a Fowler-Nordheim type at low field. At high field, the behavior can be considered as ideal. It is shown that this excess current is related to the presence of localized faults with an area between 10(exp -13) and 10(exp -18) sq cm. Correlation between the low level excess current and the oxide breakdown strength is established for the medium field range of 6 to 12 MV/cm. ESA

N92-19407# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).

DESIGN AND FABRICATION OF HIGH POWER, HIGH FREQUENCY GaAs/GaAlAs HETEROJUNCTION BIPOLAR TRANSISTORS Ph.D. Thesis - Toulouse Univ. [CONCEPTION ET REALISATION DE TRANSISTORS BIPOLAIRES HYPERFREQUENCE DE PUISSANCE A HETEROJUNCTION GAAS/GAALAS]

Thierry Camps 1991 152 p In FRENCH; ENGLISH summary

(LAAS-91258; ETN-92-90670) Avail: NTIS HC/MF A08

A detailed study of the influence of parasitic elements on device performance is presented. The particular importance of the inductance and resistance of the emitter is revealed, and techniques are suggested for minimizing these effects. The various processing technologies used and developed to manufacture the transistors are described. Particular emphasis is placed on the critical stages of emitter definition by reactive ion etching and ohmic contact formation. The results of characterization of the devices developed are presented and compared with theoretical predictions. ESA

N92-19452# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

A TIME-DEPENDENT ADAPTIVE FILTER FOR COCHANNEL INTERFERENCE REDUCTION M.S. Thesis

Matthew H. Foster Dec. 1991 121 p

(AD-A243800; AFIT/GE/ENG/91D-19) Avail: NTIS HC/MF A06 CSCL 20/14

This thesis presents a Time Dependent Adaptive Filter (TDAF) which exploits the cyclostationarity of digitally modulated communications signals and seeks to improve the Signal to Interference Ratio (SIR) and Signal to Noise Ratio (SNR) of such signals. The TDAF is embedded in a computer simulation of a simple communication system consisting of a data source, data formatter, pulse shaping filter, BPSK modulator, and demodulator. In the simulation the TDAF and a Time Independent Adaptive Filter (TIAF) attempt to extract the Signal of Interest (SOI) from noise or interference. The criteria of Mean Squared Error (MSE) is used as the primary means to compare the performance of the two adaptive filters. For plots of MSE improvement in interference, the improvement is measured as a function of the baud rate of the interference signal, and carrier frequency of the interference signal. It is shown that with respect to the TIAF, the TDAF provides up to 12 dB of improvement. Bit Error Rates (BER) for several simulations are presented. The data indicate that significant improvements in BER might be expected when a TDAF is used in lieu of a TIAF. GRA

N92-19456# Washington Univ., Seattle. Lab. for Integrated Systems.

OPTIMAL RETIMING OF MULTI-PHASE, LEVEL-CLOCKED CIRCUITS

Brian Lockyear and Carl Ebeling Oct. 1991 36 p

(Contract N00014-91-J-4041)

(AD-A243958; NWLIS-TR-91-10-01) Avail: NTIS HC/MF A03 CSCL 09/1

Using level-sensitive latches instead of edge-triggered registers for storage elements in a synchronous system can lead to faster and less expensive circuit implementations. This advantage derives from an increased flexibility in scheduling the computations performed by the circuit. In edge-clocked circuits the amount of time available for the computation between two registers is precisely the length of the clock cycle, while in circuits using level-sensitive latches a computation can borrow time across latches thus reducing the amount of dead time in the clock cycle. In either type of circuit, achieving maximum performance requires locating the storage elements in such a way as to spread the computation uniformly across a number of clock cycles. Retiming is the process of rearranging the storage elements in a circuit to reduce the cycle time or the number of storage elements without changing the interface behavior of the circuit as viewed by an outside host. Retiming in effect reschedules the circuit computations is time based on the length of those computations. In this paper, we extend the retiming techniques developed for edged-clocked circuits by Leiserson, Rose and Saxe to a general class of multi-phase, level-clocked circuits. We first describe this class of well-formed circuits and define what it means for a well-formed, level-clocked circuit to operate correctly. We then show that a set of constraints can then be used to retime a level-clocked circuit using efficient integer linear programming techniques similar to those used for edge-clocked circuits. GRA

N92-19484# Stanford Univ., CA. Dept. of Electrical Engineering.
THE FABRICATION, MICROSTRUCTURAL CHARACTERIZATION, AND INTERNAL PHOTORESPONSE OF PLATINUM SILICIDE/p-TYPE SILICON AND IRIDIUM SILICIDE/p-TYPE SILICON SCHOTTKY BARRIER PHOTODETECTORS FOR INFRARED FOCAL PLANE ARRAYS Final Report, May 1986 - Oct. 1989
Douglas E. Mercer Oct. 1991 171 p
(Contract F19628-86-K-0023)
(AD-A243994; SU-RL-TR-91-272) Avail: NTIS HC/MF A08
CSCL 09/1

Two dimensional staring arrays of PtSi/p-Si Schottky barrier photodiodes have proven their effectiveness in high-resolution infrared imaging applications over the past decade. The ease with which highly uniform arrays can be fabricated using standard silicon planar processing techniques provides a definite advantage over competing technologies. However, the maximum quantum efficiency which these detectors have achieved is at best a few percent in the region of interest. This fact has motivated studies of both fundamental limitations governing Schottky detector performance and the potential for increasing the quantum efficiency through process optimization. In this dissertation, the basic concepts, merits, and problems associated with the use of Schottky photodetectors for infrared imaging are outlined. The mechanisms which determine the photoresponse of an array element are discussed with the aid of a model developed during the course of this work. The model resembles that used to describe thermal diffusion yet incorporates the effects of energy losses due to phonon emission and the energy dependence of both the barrier transmission function and the scattering parameters. GRA

N92-19517# Arizona State Univ., Tempe.
QUANTUM TRANSPORT IN SEMICONDUCTORS Final Report, 15 May 1988 - 15 Aug. 1991
David K. Ferry 1 Oct. 1991 19 p
(Contract DAAL03-88-K-0055)
(AD-A244101; ARO-25015.5-EL) Avail: NTIS HC/MF A03
CSCL 20/12

This final report describes a program of research investigating quantum effects which become important in ultra-small semiconductor devices, and the manner in which these effects may limit down-scaling of individual feature sizes. These structures are important for both dense VLSI and millimeter wave usage. In such small devices, where individual feature sizes may be only a few tens of nanometers, significant device performance is dependent upon dynamic transient response effects which become quantum mechanical in nature. Both the time scale and the space scale involved is such that the quantum nature of the transport can greatly modify the normally expected semiclassical response. GRA

N92-19554 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
THE PLASMON MECHANISM OF HIGH TEMPERATURE SUPERCONDUCTIVITY [PLAZMONNYI MEKHANIZM VYSOKOTEMPERATURNOI SVERKHPROVODIMOSTI]
E. A. Pashitskii 1989 53 p In RUSSIAN
Copyright Avail: Issuing Activity

This work examines an anisotropic charge-invariant model of the 'plasmon' mechanism of superconductivity in layered metal with a quasi one-dimensional zone spectrum in the foundation of which lies cooper pairing of electrons (apertures) on flattening ranges on the surface of the lattice due to interaction with low-frequency random plasmons and distributed in the direction of the 'heavy' mass. It is shown that such a model can explain an entire series of specific peculiarities of high temperature superconductors in cooper metal oxide compounds.
Transl. by L.K.H.

N92-19565 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. for Problems of Power Modelling.
APPROXIMATING PULSE SPECTRA AS APPLIED TO FRACTIONAL-DIFFERENTIAL ANALYSIS [APPROKSIMIRUIUSHCHE IMPULSNYE SPEKTRY V PRILOZHENII K DROBNO-DIFFERENTSIAL NOMA ANALIZU]
L. A. Simak 1989 54 p In RUSSIAN
Copyright Avail: Issuing Activity

A variant of operational methodology for analysis of dynamic systems based on approximations of pulse spectras (APS-conversion) is studied. The characteristics of the derived spectra are studied and operational matrices and recurring relationships are proposed which make possible the algebrazation of mathematical models of dynamic systems with integro-differential operators of non-integer series, elemental time lag, and the like. This work is for specialists doing research of dynamic systems and operational methods of analysis. Transl. by L.K.H.

N92-19570# Argonne National Lab., IL.
SELF-RECOVERING SUPERCONDUCTING STRIP DETECTORS
A. Gabutti and K. E. Gray Sep. 1991 10 p Presented at the 4th International Workshop on Low Temperature Detectors and Dark Matter, Oxford, England, 4-7 Sep. 1991
(Contract W-31-109-eng-38)
(DE92-004148; ANL/CP-74584; CONF-9109317-1) Avail: NTIS HC/MF A02

Using a 1.8 micron wide superconducting strip made of granular tungsten, we have observed self-recovering pulses when the detector is irradiated with an Fe-55 6 keV X-rays source. For low values of the bias current (i.e. I(sub b) less than 30 mu A at T(sub b) = 1.5K), the superconducting state is recovered in 10-50 ns giving voltage pulses across the strip of few hundred mu v in amplitude. At high bias currents the detector did not self-recover and a constant counting efficiency has measured at different operating temperatures. There are good indications that this high counting rate can be extended to all the reduced bias currents where the detector is able to reset itself after every switch. The current threshold between collapsing and propagating switches and the time evolution of the voltage pulses can be described using a thermal propagation model developed in previous works. The ability of detectors to automatically recover the superconducting state in a short period of time after sensing a particle is encouraging in the feasibility study of fast superconducting microvertex detectors and also confirm the potential application of superconducting strips as high fast resolution X-rays detectors. DOE

N92-19578# EG and G Rocky Flats, Inc., Golden, CO.
A CIRCUIT FOR MONITORING ELECTRIC CURRENTS PRODUCED BY A TWIN BRIDGE CALORIMETER Patent Application
T. P. Donohoue, inventor (to DOE), C. P. Oertal, inventor (to DOE), W. H. Tyree, inventor (to DOE), and J. L. Valdez, inventor (to DOE) 19 Jun. 1990 14 p
(Contract DE-AC34-90DP-62349)
(DE92-003811; US-Patent-Appl-SN-540240;
Patents-US-A7540240) Avail: NTIS HC/MF A03

A circuit for measuring temperature differentials in a calorimeter is disclosed. The temperature differential between the reference element and sample element containing a radioactive material is measured via a wheatstone bridge arrangement of thermistors. The bridge is driven with an alternating current on a pulsed basis to maintain the thermal floor of the calorimeter at a low reference value. A lock-in amplifier connected to the bridge phase locks a signal from the bridge to the input pulsed AC signal to provide a DC voltage. The DC voltage is sampled over time and provided to a digital computer. The digital computer, using curve fitting algorithms, will derive a function for the sample data. From the function, an equilibrium value for the temperature may be calculated. DOE

N92-19580# Sandia National Labs., Albuquerque, NM.
DRY WRAP AND FILL SHAPED CAPACITORS FOR WEAK LINK APPLICATIONS
J. D. McBrayer, R. A. Brooks, and J. C. Foster (General Electric Co., Largo, FL.) 1992 4 p Presented at the 12th Capacitor and Resistor Technology Symposium, Tucson, AZ, 16-19 Mar. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004356; SAND-91-2021C; CONF-920372-2) Avail: NTIS HC/MF A01

The use of capacitors to intrinsically fail first when a system is subjected to abnormally high thermal environments guarantees no unexpected responses by the system to these environments. This type of system protection is called a thermal-weak-link protected system. Thermal-weak-link applications may be implemented by placing a weak-link capacitor between the abnormal thermal source and the rest of the system. This paper will discuss specially shaped capacitors that allow the capacitor to shield the vital parts of the electrical system. The design and process parameters will be presented. Electrical data is discussed for each type of capacitor. Short Term Breakdown voltages as high as 13,000 Vdc have been achieved for 0.3 microfarad capacitors. DOE

N92-19581# Sandia National Labs., Albuquerque, NM.
A TEST VEHICLE TO ASSESS STRESS VOIDING MODELS AND ACCELERATION METHODS
W. F. Filter and J. A. VanDenAvyle 1991 16 p Presented at First International Workshop on Stress Induced Phenomena in Metalizations, Ithaca, NY, 11-13 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE92-004359; SAND-91-2338C; CONF-9109327-1) Avail: NTIS HC/MF A03

We have designed and manufactured a test chip devoted to the study of interconnect voiding. The test chip is suitable for evaluating theoretical models, acceleration recipes, and the effects of process variations. We describe the chip and a simple, stress-free packaging technique that eliminates any stress to the chip from die bonding or packaging thermal cycles. With this test chip, we can perform many necessary and desirable experiments: determining stress, observing or stimulating void growth, profiling hydrogen concentrations, and measuring excess current noise. We report here preliminary measurements of residual stress, observations of voids, and determinations of hydrogen concentrations of hydrogen concentration under variations in aluminum annealing and passivation. In agreement with observations elsewhere, we find that passivations which differ greatly in intrinsic stress do not differ much in the stress they impart to patterned metal; some workers have suggested instead that excess hydrogen in the aluminum contributes to voiding. Following this lead, we have used nuclear reaction analysis to profile the hydrogen concentration in passivation, metallization, barrier metal, and interlevel dielectric and present some preliminary measurements here. We conclude that passivated metallization may contain as much as 0.1 atomic percent hydrogen. DOE

N92-19589# Sandia National Labs., Albuquerque, NM.
RADIATION COMPENSATED OPTICALLY-TRIGGERED GaAs AND Si THYRISTOR SWITCHES
R. F. Carson 1991 9 p Presented at the Department of Defense (DOD) Fiber Optics Conference, McLean, VA, 25 Mar. 1992
(Contract DE-AC04-76DP-00789)
(DE92-003950; SAND-91-2705C; CONF-920367-1) Avail: NTIS HC/MF A02

Optically triggered thyristors are hardened to switching in high dose rate transient x ray environments by adding compensating photodetectors that are shielded from the light signal but are sensitive to ionizing radiation. Silicon thyristors are packaged with compensating photodiodes that reduce sensitivity to premature switching by transient radiation by a factor of 100. GaAs devices are monolithically integrated with a photo-transistor and are resistant to radiation induced switching (or 'upset') up to 2 x 10(exp 9) (Rad (Si)/(sec)). This is a factor of 10 increase in tolerance to upset over uncompensated two-terminal GaAs thyristors. DOE

N92-19600# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Groupe Composants Bipolaires.
STUDY AND DESIGN OF A BRIDGE ARM FOR A VERY HIGH FREQUENCY RESONANT DC-DC CONVERTER Ph.D. Thesis - Inst. National Polytechnique
Jean-Pierre Laur 1991 120 p In FRENCH; ENGLISH summary
(LAAS-91304; ETN-92-90947) Avail: NTIS HC/MF A06

The study and design of a bridge arm, intended for use in a very high frequency half bridge series resonant DC-DC converter are presented. For a specific set of specifications the structure best suited for the application considered is shown. The emphasis is placed on criteria such as the frequency rise capability and operating safety. The theoretical consideration of these resonant converters leads to complex and interdependent relationships rendering dimensioning delicate. A method for determining series resonant converter elements is proposed. The influence of the variation of the designer's selected parameter on the different electric variable requirements of the structure is shown. The switches of the structure retained and the converter arm realized with power Metal Oxide Semiconductors (MOS) transistors mounted as dual thyristors are investigated. The results of the simulations performed with SPICE software are compared to the experimental results obtained from a prototype supplied with rectified and filtered 220 V mains, delivering a nominal power of 150 W at a frequency of 600 kHz; the operating point at minimum load (20 percent of nominal power) is obtained at a frequency of 1.3 MHz. ESA

N92-19601# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Equipe Circuits et Composants a Effect de Champ Micro-Ondes.
GaAs MESFET LARGE SIGNAL MODELISATION: APPLICATION TO THE DESIGN OF A MONOLITHIC LOW PHASE DISTORTION POWER LIMITER Ph.D. Thesis - Toulouse Univ.
Thierry Parra 1991 161 p In FRENCH; ENGLISH summary
(LAAS-91303; ETN-92-90948) Avail: NTIS HC/MF A08

The problem of phase distortion, which occurs when a GaAs Field Effect Transistor (FET) is operated beyond its compression point is addressed. A large signal modelization is developed to account for this effect and used for the design of a monolithic low phase distortion FET power limiter. Accurate electrical characterizations (static, linear and large signal microwave) conducted on a set of several FETs are presented. Possible origins of phase distortion are proposed and a possible technique to select minimum phase distortion devices is suggested. Nonlinear FETs modes are carried out from these measurements. Nonlinear simulations are conducted so as to derive optimum matching and biasing circuits providing phase distortion minimization. Some original results are presented and used for the optimum design of a monolithic low phase distortion FET power limiter. This limiter was processed and its measured performances are given. Applications of the work, such as a variable power constant phase amplifier or a predistortion linearizer, are also presented. ESA

N92-19626# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
NREL PREPRINTS FOR THE 22ND IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE
E. Nelsen, ed. Oct. 1991 153 p Conference held in Las Vegas, NV, 7-11 Oct. 1991
(Contract DE-AC02-83CH-10093)
(DE92-001154; NREL/TP-210-4567; CONF-911055) Avail: NTIS HC/MF A08

This document contains preprints of papers prepared by photovoltaic scientists at the National Renewable Energy Laboratory and collaborating researchers for the 22nd IEEE Photovoltaic Specialists Conference. Preparation, fabrication, testing, and manufacturing of solar cells are discussed. The

materials for high efficiency solar cells are characterized by their electrical properties, optical properties, microstructure, and method of preparation. DOE

N92-19641# Pacific Northwest Lab., Richland, WA.
TEST PLAN FOR THE PILOT CELL TEST OF INERT ANODES: REPORT ON THE JUNE 1991 MEETING AT THE REYNOLDS METALS COMPANY FACILITY
C. F. Windisch, Jr., T. R. Alcorn, and A. T. Tabereaux (Reynolds Metals Co., Muscle Shoals, AL.) Sep. 1991 38 p
(Contract DE-AC06-76RL-01830)
(DE92-001793; PNL-7802) Avail: NTIS HC/MF A03

The Inert Electrodes Program at the Pacific Northwest Laboratory (PNL) is supported by the Office of Industrial Processes (OIP) of the U.S. Department of Energy (DOE) and is aimed at improving the energy efficiency of Hall-Heroult cells through the development of inert anodes. The inert anodes currently under study are composed of a cermet material of the general composition NiO-NiFe2O4-Cu. The program has three primary objectives: (1) evaluate the anode material in a pilot cell facility, (2) investigate the mechanisms of the electrochemical reactions at the anodes surface, and (3) develop sensors for monitoring various anode and/or electrolyte conditions. This report discusses a test plan that has been developed for the pilot cell test of the inert anodes. DOE

N92-19643# Quad Design Technology, Inc., Camarillo, CA.
APPLICABILITY OF SUPERCONDUCTING INTERCONNECTION TECHNOLOGY FOR HIGH SPEED ICs AND SYSTEMS Final Quarterly Report
Oct. 1991 230 p
(Contract N00014-90-C-0217)
(AD-A242927) Avail: NTIS HC/MF A11 CSCL 09/1

The studies and analysis discussed in the quarterly reports on the program indicate that there are strong advantages for the use of high temperature superconductors for the signal interconnections in large, very high density 2-dimensional multi-chip modules of the types illustrated. MCMs is described in detail, an analysis is given of the number of signal interconnect layers versus MCM size for maximal density (surface 'tiled' width IC chips with minimal spacing between them) square MCMs. The comparison, between room temperature copper and HTSC interconnect materials, is based on a number of assumptions described in detail in that section. The assumptions include: (1) chip I/O counts determined from Rent's rule as published by IBM for high performance chips (e.g., 370 I/O's for a 10,000 gate chip, taken to be 0.6 cm square), (2) average wire lengths from Donath model with Rent's rule exponent of p = 2/3, (3) a conductor width of W, a thickness of W/2 and spacing of 3W, where W is the same for all conductors and selected to meet line resistance limitations, (4) a 40 percent utilization of theoretical channel space by actual interconnects (40 percent wiring efficiency), and (5) the longest line does not exceed two times the MCM size (i.e., corner to corner line with Manhattan wiring with no wrong way routing). GRA

N92-19660# Oak Ridge National Lab., TN.
THE EFFECTS OF NONSTANDARD LIGHTNING VOLTAGE WAVESHAPES ON THE IMPULSE STRENGTH OF AIR GAPS
P. Chowdhuri, A. K. Mishra, P. M. Martin, and B. W. McConnell 1991 7 p Presented at the IEEE Power Engineering Society (PES) Winter Meeting, New York, NY, 2-6 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-003530; CONF-920202-2) Avail: NTIS HC/MF A02

Sphere-sphere, rod-rod, and rod-plane air gaps, each 5-cm long, were tested with lightning surges of eight voltage waveshapes of both polarities. The critical breakdown voltage of the tested air gaps showed a minima at a certain voltage wavefront. Long time delays of breakdown for the fast-front and short time delays for the slow-front waves were observed. These phenomena would significantly affect the insulation coordination of the power apparatus and system. DOE

N92-19686# National Inst. of Standards and Technology, Gaithersburg, MD. Center for Electronics and Electrical Engineering.
TECHNICAL PUBLICATION ANNOUNCEMENTS COVERING CENTER PROGRAMS, OCTOBER - DECEMBER 1990, WITH 1991 CEEE EVENTS CALENDAR
J. A. Gonzales Aug. 1991 32 p
(PB91-240838; NISTIR-4645) Avail: NTIS HC/MF A03 CSCL 09C

This is the 27th issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology Center for Electronics and Electrical Engineering. This issue covers the fourth quarter of calendar year 1990. Abstracts are provided by technical area for papers published this quarter. Author

N92-19852# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
SUPERCONNECTIONS AND THE NOVIKOV CONJECTURE (REVISED VERSION)
J. Lott Oct. 1991 44 p Prepared in cooperation with Michigan Univ., Ann Arbor
(PB92-114115; IHES/M/91/66) Avail: NTIS HC/MF A03 CSCL 09C

The index theoretic approach to the Novikov conjecture is based on a theorem which computes the pairing of group cohomology with the Chern character of the index of an elliptic operator. Using superconnections, a heat equation proof is given of this theorem on the level of differential forms on a noncommutative base space. As a consequence, a new proof is obtained of the Novikov conjecture for hyperbolic groups. Author

N92-19855# Brookhaven National Lab., Upton, NY.
PERFORMANCE OF A SUPERCONDUCTING, HIGH FIELD SUBCENTIMETER UNDULATOR
I. Ben-Zvi, R. Fernow, J. Gallardo, G. Ingold, W. Sampson, and M. Woodle 1991 24 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005392; BNL-46713; CONF-9108118-1) Avail: NTIS HC/MF A03

A superconducting 8.80 mm wavelength undulator is under construction for the 500 nm Free-Electron Laser at the Accelerator Test Facility (ATF) at Brookhaven National Laboratory. We present results on the design, construction and performance of this novel undulator structure. A field on axis of 0.51T has been measured for a 4.40 mm gap, with a current 20 percent below the quench current. Our simple design focuses on minimizing the accumulation of errors by minimizing the numbers of parts and by using a ferromagnetic yoke. The magnetic field error is less than 0.30 percent rms as manufactured (without shimming). The third harmonic content is less than 0.1 percent of the fundamental. DOE

N92-19878# Allied-Signal Aerospace Co., Kansas City, MO.
EFFECT OF OXYGEN PLASMA CLEANING ON THIN FILM RESISTORS
C. T. Fritsche Dec. 1991 17 p
(Contract DE-AC04-76DP-00613)
(DE92-004884; KCP-613-4507) Avail: NTIS HC/MF A03

An investigation was performed to determine the effect of oxygen plasma cleaning on thin film network (TFN) resistors for the purpose of proving-in plasma cleaning of hybrid microcircuits (HMCs) to remove flux stains. The investigation was performed using stabilized production thin film edge monitors as test samples. Both tantalum nitride and titanium palladium resistors were evaluated. The plasma cleaning was performed in a Branson/IPC S2050T-11020 plasma cleaner using a schedule of 0.7 torr oxygen, 150 watts power, for 30 min. The cleaned edge monitors were cleaned twice to represent a worst case condition. It was determined that the tantalum nitride edge monitor resistors tested changed on average + 0.029 percent in value due to plasma

cleaning and changed on average + 0.040 percent more in value after life testing. The titanium palladium edge monitor resistors tested were significantly affected by plasma cleaning, but the percent change is less clear due to the difficulty encountered in accurately measuring resistance changes on these resistors. The titanium palladium resistors' shift after plasma cleaning may not be significant, but the plasma cleaned resistors did change on average minus 0.867 percent in value after life testing compared to the uncleaned resistors. DOE

N92-19892# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Mechanical Engineering.
ANALYTICAL INVESTIGATION OF THE ACCELERATION SENSITIVITY OF ACOUSTIC BULK AND SURFACE WAVE RESONATORS Final Report, 15 Jul. 1988 - 14 Jul. 1991
Harry F. Tiersten Oct. 1991 8 p
(Contract DAAL03-88-K-0065)
(AD-A244394; ARO-25697.11-PH) Avail: NTIS HC/MF A02 CSCL 09/4

An analysis of the in-plane acceleration sensitivity of ST-cut quartz surface wave resonators with the substrate extending beyond interior rectangular supports was performed. An analysis of the normal acceleration sensitivity of contoured AT- and SC-cut quartz crystal resonators supported along rectangular edges was performed. In subsequent work it was shown analytically that the normal acceleration sensitivity of contoured quartz resonators with rectangular supports vanishes when the centers of the mode shape and support rectangle coincide. It has further been shown that the resultant in-plane acceleration sensitivity of contoured quartz resonators with rectangular supports vanishes when the centers of the support rectangle and the mode shape coincide and the active resonator region is supported symmetrically on both sides. Since the resultant in-plane acceleration sensitivity vanishes when the centers of the support rectangle and the mode shape coincide, an analysis of the influence of a relative displacement of the center of the mode shape with respect to rectangular supports was performed. GRA

N92-19923# Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Chemistry.
IMPEDANCE MEASUREMENT OF SOME SUPERCONDUCTING CERAMICS M.S. Thesis
U. Akhtar Feb. 1991 170 p
(PB92-126051) Avail: NTIS HC/MF A08 CSCL 09A

Impedance measurements were carried out using various RC circuits with standard capacitors and resistors. From these measurements, calibration curves were made for the use in actual electrochemical systems. A simple electrochemical system may be depicted by the Randle type system for which, when a graph is plotted for positive values, between real and imaginary components of impedance, a semicircle is obtained. In an actual electrochemical system, a graph is plotted between a real and an imaginary component of impedance and the shape of the graph is used to find out electrochemical equivalent circuits. Futhermore, from the plot, valuable data about magnitude of electrical circuit elements are also obtained. Author

N92-19982# Sandia National Labs., Albuquerque, NM.
LIGHT EMISSION MICROSCOPY
J. M. Soden and E. I. Cole, Jr. 1992 16 p Presented at the IEEE International Reliability Physics Symposium, San Diego, CA, 30 Mar. - 2 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-006735; SAND-92-0145C; CONF-920327-2) Avail: NTIS HC/MF A03

Light emission microscopy is now currently used in most integrated circuit (IC) failure analysis laboratories. This tutorial is designed to benefit both novice and experienced failure analysts by providing an introduction to light emission microscopy as well as information on new techniques, such as the use of spectral signatures. The use of light emission for accurate identification and spatial localization of physical defects and failure mechanisms is presented. This includes the analysis of defects such as short circuits which do not themselves emit light. The importance of understanding the particular IC design and applying the correct electrical stimulus is stressed. A video tape is used to show light emission from pn junctions, MOS transistors, test structures, and CMOS ICs in static and dynamic electrical stimulus conditions. DOE

N92-20015# National Inst. of Standards and Technology, Gaithersburg, MD. Semiconductor Electronics Div.
ELECTRONICS AND ELECTRICAL ENGINEERING LABORATORY TECHNICAL PUBLICATION ANNOUNCEMENTS COVERING LABORATORY PROGRAMS, JANUARY TO MARCH 1991, WITH 1991 EEEL EVENTS CALENDAR
J. A. Gonzalez Sep. 1991 20 p
(PB92-112309; NISTIR-4675) Avail: NTIS HC/MF A03 CSCL 09C

This is the twenty-eighth issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology, Electronics and Electrical Engineering Laboratory (EEEL). The issue of the EEEL Technical Publication Announcements covers the first quarter of calendar year 1991. Abstracts are provided by technical area for papers published this quarter. Major topic areas include the following: semiconduction microelectronics; signal acquisition, processing, and transmission; electrical systems; and electromagnetic interference. GRA

N92-20040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ELECTRICAL PROPERTIES OF TEFLON AND CERAMIC CAPACITORS AT HIGH TEMPERATURES
A. N. Hammoud (Sverdrup Technology, Inc., Brook Park, OH.), E. D. Baumann, I. T. Myers, and E. Overton 1992 6 p Proposed for presentation at the 1992 International Symposium on Electrical Insulation, Baltimore, MD, 7-9 Jun. 1992; sponsored by IEEE Dielectrics and Electrical Insulation Society
(NASA-TM-105569; E-6894; NAS 1.15:105569) Avail: NTIS HC/MF A02 CSCL 09A

Space power systems and components are often required to operate efficiently and reliably in harsh environments where stresses, such as high temperature, are encountered. These systems must, therefore, withstand exposure to high temperature while still providing good electrical and other functional properties. Experiments were carried out to evaluate Teflon and ceramic capacitors for potential use in high temperature applications. The capacitors were characterized in terms of their capacitance and dielectric loss as a function of temperature, up to 200 C. At a given temperature, these properties were obtained in a frequency range of 50 Hz to 100 kHz. DC leakage current measurements were also performed in a temperature range from 25 to 200 C. The results obtained are discussed and conclusions are made concerning the suitability of the capacitors studied for high temperature applications. Author

N92-20041# Westinghouse Electric Corp., Pittsburgh, PA. Science and Technology Center.
INVESTIGATION OF MICROWAVE MONOLITHIC INTEGRATED CIRCUIT (MMIC) NON-RECIPROCAL MILLIMETERWAVE COMPONENTS Final Report, Mar. 1987 - Jan. 1990
S. H. Talisa, S. V. Krishnaswamy, J. D. Adam, K. C. Yoo, and N. J. Doyle Sep. 1991 90 p
(Contract F19628-87-C-0101)
(AD-A243121; RL-TR-91-244) Avail: NTIS HC/MF A05 CSCL 09/1

Two ferrite film deposition techniques were investigated in this program for possible use in the monolithic integration of Gallium Arsenide electronic and magnetic millimeter-wave devices; (1) spin-spray plating (SSP) of nickel zinc ferrite films, and (2) sputtering of barium hexaferrites with C-axis oriented normally to the film plane. The SSP technique potential for this application was demonstrated. Film structural characteristics were studied, as well as their adhesions to other substrates and the conditions for growth of thicker films. Multilayers totalling 25 microns in thickness were

grown on semiconducting substrates. The SSP process occurs at about 100 C and was experimentally demonstrated not to damage Gallium arsenide MMIC devices. The magnetic characteristics of these films were comparable to ceramic materials. A scheme for the monolithic integration of magnetic and Gallium arsenide electronic devices was proposed and its feasibility experimentally demonstrated. The films showed higher dielectric loss than was desirable, possibly owing to high water content. A better drying technique is required. Barium ferrite films with C-axis texture were reproducibly grown on sapphire. Magnetic measurements yielded acceptable saturation magnetization and anisotrophy field. Ferromagnetic resonance was not observed, possibly due to broad linewidths. Author (GRA)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-19033# Naval Postgraduate School, Monterey, CA.
HEAT TRANSFER, ADIABATIC EFFECTIVENESS, AND INJECTANT DISTRIBUTIONS DOWNSTREAM OF SINGLE ROWS AND TWO STAGGERED ROWS OF FILM-COOLING HOLES WITH SIMPLE AND COMPOUND ANGLES M.S. Thesis
Stephen M. Jackson Dec. 1991 242 p
(AD-A244372) Avail: NTIS HC/MF A11 CSCL 01/1

Experimental results for two compound angle injection systems (configurations 1 and 3), and for a simple injection system (configuration 2) are compared in this thesis. The effects of blowing ratio, spanwise hole spacing, hole angle orientation, and streamwise position (x/d) are discussed in reference to measurements of spanwise-averaged adiabatic effectiveness, iso-energetic Stanton number, and Stanton number 0 approximately equal to 1.5 obtained downstream of both one row of holes and two staggered rows of holes. Results indicate that effectiveness depends mostly on four parameters: simple or compound angle injection, spanwise hole spacing, one or two rows of holes, and blowing ratio. Results show that for a specified blowing ratio, for all configurations tested to date, spanwise-averaged adiabatic effectiveness is greatest at lower x/d values but decreases with streamwise development as the injectant convected downstream. The rate of spanwise-averaged adiabatic effectiveness decrease is dependent on the blowing ratio, and mostly a result of lift-off of the injectant from the test surface at x/d values less than about 20. At larger x/d, spanwise-averaged adiabatic effectiveness values generally increase with blowing ratio mostly because of greater amounts of injectant along the test surface. Results also show that the iso-energetic Stanton number ratio lies between 1 and 1.35 for all cases studied and generally increases with blowing ratio for a given x/d. GRA

N92-19034# Louisiana State Univ., Baton Rouge. Dept. of Mechanical Engineering.
INVESTIGATION OF TURBULENT JET IMPINGEMENT IN A CONFINED CROSSFLOW Final Report, 1 Sep. 1988 - 1 Dec. 1990
George D. Catalano 4 Nov. 1991 84 p
(Contract F33615-88-C-3004)
(AD-A244374; WL-TR-91-3069) Avail: NTIS HC/MF A05 CSCL 20/4

Measurements and computations are reported for the flow of a turbulent jet discharging into a crossflow confined between two parallel plates. For jet-to-crossflow velocity ratios R equal to 2 and 4, mean and fluctuating velocity components are measured by a laser Doppler anemometer. High order statistics of the streamwise velocity and its time derivative have been measured in the plane of symmetry of a jet in a confined crossflow. The existence of universal similarity of the fine scale structure of a developing turbulent velocity field and the validity of original Kolmogorov local similarity theory and later formulations were investigated. Construction of normalized spectral for energy content, dissipation, and higher order moments enable an examination of the Reynolds number dissipation, and higher order moments enable an examination of the Reynolds number dependence of these functions for the Re sub lamda range from 16 to 800. Estimates of the Kolmogorov constant, mu, ranging from 0.27 to 0.43 were obtained with the arithmetic average equal to 0.38. The fractal dimension of the fine scale structure was estimated from the functional relationship between the flatness of the velocity time derivative and Re sub lambda. For unfiltered data, the fractal dimension was estimated to be 2.45. However, with a + or - 12 sigma bandwidth, the fractal dimension increased to 2.73. GRA

N92-19036# Minnesota Univ., Minneapolis. Inst. for Mathematics and Its Applications.
NONLINEAR WAVES, DYNAMICAL SYSTEMS, AND OTHER APPLIED MATHEMATICS PROGRAMS Final Report, 1 Aug. 1988 - 31 Jul. 1991
Willard Miller, Jr. and Avner Friedman 4 Oct. 1991 100 p
(Contract DAAL03-88-K-0132)
(AD-A244376; ARO-25782.26-MA) Avail: NTIS HC/MF A05 CSCL 20/4

This grant provided partial support for IMA academic year programs on nonlinear waves (1988-89), Dynamical Systems (1989-90), and Phase Transitions (1990-91). Each program involved approximately 700 researchers. A total of approximately 400 preprints and approximately 25 proceedings volumes of research results were produced. Of particular note were the 8 one week workshops supported by ARO which focused attention on special subject areas in these fields which are of particular interest at the present time. GRA

N92-19052# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
NUMERICAL SOLUTION OF THREE-DIMENSIONAL UNSTEADY VISCOUS FLOWS Progress Report, 1 Jun. - 30 Nov. 1991
Lakshmi N. Sankar 30 Nov. 1991 22 p
(Contract N00014-89-J-1319)
(AD-A244274) Avail: NTIS HC/MF A03 CSCL 20/4

In many fluid dynamics problems, the flows are three-dimensional, unsteady and turbulent. Flow past submarine configurations, flow through marine propellers and turbomachinery are examples of such flows. Numerical procedures for accurate and efficient computations of such flows are presently not possible due to mixed elliptic-parabolic nature of the governing equations. Indeed, methods for 3-D incompressible flows lag behind 3-D compressible flows by several years. Until accurate and efficient methods for 3-D incompressible, unsteady flows become available, it will be possible to attempt challenging problems such as first principles based direct simulations of turbulent flow over marine vehicles. The long term objective of the present effort is the development of solution techniques for direct numerical simulation of unsteady 3-D incompressible turbulent flows. The kinetic aspects of this problem are governed by a set of parabolic partial differential equations, which may be efficiently integrated by a variety of time marching schemes. The kinematic aspects of this flow such as the relationship between velocity and vorticity, and the relationship between velocity and pressure are governed by elliptic partial differential equations, which can be solved at any instance in time, only by iterative techniques. GRA

N92-19066# Cornell Univ., Ithaca, NY. Coll. of Engineering.
STUDIES IN GLOBAL, BIFURCATION AND SYMMETRY Final Report, 1 Dec. 1988 - 31 May 1991
Phillip Holmes 31 May 1991 12 p
(Grant AF-AFOSR-0200-89; AF Proj. 2304)
(AD-A243862; AFOSR-91-0928TR) Avail: NTIS HC/MF A03 CSCL 20/4

Models of Turbulent Boundary Layers used the proper

orthogonal decomposition theorem to provide optimal bases for finite dimensional subspaces so that relatively low dimensional projections of the Navier-Stokes equations can be calculated. These dynamical systems retain key features of the turbulence production mechanisms. The inherit symmetries from physical space which lead to the existence of structurally stable heteroclinic cycles, in turn creating intermittent dynamics remarkably similar to the bursting phenomenon observed in experiments. Ours are perhaps the first rationally derived low (-10 to 50) dimensional models for turbulence in open flows and they offer promise of improved understanding of basic mechanisms and design of drag control strategies. Unlike other groups using Karhunen-Loeve methods, we have carried out rather complete analyses of the projected ODE's. This work resulted in papers and also led to the mathematical questions. GRA

N92-19080# Arnold Engineering Development Center, Arnold Air Force Station, TN.
ASYMPTOTIC THEORY OF TRANSONIC WIND TUNNEL WALL INTERFERENCE Final Report, 30 Mar. 1984 - 30 Jul. 1990
N. D. Malmuth, C. C. Wu, H. Jafroudi, R. Mclachlan, and J. D. Cole Dec. 1991 230 p
(Contract F40600-84-C-0010)
(AD-A244075; AEDC-TR-91-24) Avail: NTIS HC/MF A11 CSCL 20/4

Two limiting cases are considered related to transonic wall interference. For the first case corresponding to slender airplanes, an area rule for interference holds in which the interference of the complete airplane can be obtained from that of its equivalent body of revolution. For large wall height, the slender case exhibits an asymptotic triple deck structure consisting of a cross flow-dominated zone near the model, a weakly perturbed free-field mid-field which has a linear multipole far field for solid and free-jet wall conditions. Nonclassical, experimentally determined pressure conditions prescribed on a cylindrical interface lead to a tube vortex far field. For a high aspect ratio second case, the interference is driven by the imaging effect of the interference on the projection of the trailing vortex system in the Trefftz plane. This gives a downwash correction to a near-field nonlinear lifting line flow. Slightly subsonic free stream conditions give a spike like interference flow field due to the shock movement for both limiting cases. Computer codes written to treat these cases, as well as the underlying numerical methods, are described. Approaches integrating the asymptotics with measurement to augment Wall Interference Assessment/Correction (WIAC) procedures are outlined. GRA

N92-19181# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INVESTIGATION OF A FLUX-DIFFERENCE-SPLITTING NUMERICAL METHOD IN SUPERSONIC NOZZLES M.S. Thesis
Danny P. Allen Dec. 1991 79 p
(AD-A244047; AFIT/GAE/ENY/91D-13) Avail: NTIS HC/MF A05 CSCL 20/4

This research investigated the effects of adding a second-order flux-difference-splitting (FDS) correction term to an existing computer code that is based on a first-order FDS algorithm. It was determined that the second-order algorithm did improve the accuracy of the code for a source flow analysis, but second-order behavior could not be confirmed by the error convergence patterns. It was also discovered that, when tested across an oblique shock wave, the second-order correction terms had minimal influence on the accuracy and shock capturing ability of the first-order accurate FDS method. GRA

N92-19183# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THERMAL NONEQUILIBRIUM EFFECTS ON TURBINE CASCADE AERODYNAMICS M.S. Thesis
Jill L. Shaw Dec. 1991 70 p
(AD-A244049; AFIT/GAE/ENY/91D-25) Avail: NTIS HC/MF A04 CSCL 20/4

The AFIT Total Variation Diminishing Euler Code (ATEC) was modified to include a thermal nonequilibrium model to investigate high temperature effects associated with vibrational relaxation in a transonic turbine cascade. Incorporation of this model into ATEC and creating ANTEC (AFIT Nonequilibrium TVD Euler Code) was accomplished in three steps. Steady-state solutions obtained with ANTEC were compared with those obtained with ATEC for various inlet and exit conditions. The Courant-Friedrichs-Levy criterion was held constant to ATEC; however, it required variation for ANTEC. Blade temperature profiles, temperature difference contours in the vicinity of the trailing edge and the value of the ratio of specific heats (gamma) along the blade were analyzed. Even when corrected for high temperatures, the assumptions of a calorically perfect gas and thus a constant value of gamma are inaccurate due to the temperature dependent nature of specific heats at constant pressure and at constant value. Maximum temperature differences of -741 K and 539 K were found near the trailing edge for the highest temperature case, with differences being most noticeable through the expansion at the trailing edge on the pressure surface and across the shocks from both surfaces. The vibrational relaxation model showed limitations at low temperatures. GRA

N92-19204# Naval Postgraduate School, Monterey, CA.
THE INTERACTION OF A SHOCK WITH A COMPRESSIBLE VORTEX Memorandum Report
Janet L. Ellzey, J. M. Picone, and Elain S. Oran 2 Jan. 1992 37 p
(AD-A244341; NRL-MR-6919) Avail: NTIS HC/MF A03 CSCL 20/4

Numerical simulation of the interaction of a shock with either a single vortex or a vortex pair is used to investigate the resulting shock structure, production of acoustic waves, vortex distortion, and vorticity amplification. The study includes the interaction of strong (Mach number = 1.5) and weak (Mach number = 1.05) shocks with both strong and weak vortices which have peak velocities equal to the velocity of the fluid behind the strong and weak shocks, respectively. The simulations show that at early times, the distortion of a shock by a strong vortex can be predicted using a simple linear model. In addition, a quadrupolar wave propagates upstream as predicted by linearized theories. At later times, the interaction of the diffracted and refracted portions of the shock produces connected reflected shock structures. For the strong shock, the reflected shock structure merges with the quadrupolar wave to produce the asymmetric acoustic wave observed in experiment. GRA

N92-19221# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CHEMICAL AND VIBRATIONAL NONEQUILIBRIUM VISCOUS FLOWS: MODELISATION, INTERNAL, AND EXTERNAL FLOWS APPLICATIONS Ph.D. Thesis - Paris VI Univ.
Cyril Flament 1991 276 p In FRENCH; ENGLISH summary Translation was announced as ESA-TT-1274
(ONERA-NT-1991-2; ISSN-0078-3781; ETN-92-90683) Avail: NTIS HC/MF A13

A numerical code is elaborated to solve chemical and vibrational nonequilibrium viscous flow problems. Transport properties, thermodynamic functions, chemical kinetics, vibrational relaxation and dissociation-vibration coupling are analyzed and used as physical models. They are used in the numerical analysis of equations involved in hypersonic flow for various nozzle and reentry body configurations. Quasi monodimensional Euler results are presented for the nozzles R6 and F4. Axisymmetric Navier-Stokes results for the flow around a sphere cylinder, and around a hyperboloid are detailed. The results are in good agreement with theoretical calculations. ESA

N92-19249*# Michigan Technological Univ., Houghton. Dept of Mechanical Engineering and Engineering Mechanics.
FILM CONDENSATION IN A HORIZONTAL RECTANGULAR DUCT Final Report
Qing Lu and N. V. Suryanarayana 20 Feb. 1992 248 p

(Grant NAG3-711)
(NASA-CR-190044; NAS 1.26:190044) Avail: NTIS HC/MF A11 CSCL 20D

Condensation heat transfer in an annular flow regime with and without interfacial waves was experimentally investigated. The study included measurements of heat transfer rate with condensation of vapor flowing inside a horizontal rectangular duct and experiments on the initiation of interfacial waves in condensation, and adiabatic air-liquid flow. An analytical model for the condensation was developed to predict condensate film thickness and heat transfer coefficients. Some conclusions drawn from the study are that the condensate film thickness was very thin (less than 0.6 mm). The average heat transfer coefficient increased with increasing the inlet vapor velocity. The local heat transfer coefficient decreased with the axial distance of the condensing surface, with the largest change at the leading edge of the test section. The interfacial shear stress, which consisted of the momentum shear stress and the adiabatic shear stress, appeared to have a significant effect on the heat transfer coefficients. In the experiment, the condensate flow along the condensing surface experienced a smooth flow, a two-dimensional wavy flow, and a three-dimensional wavy flow. In the condensation experiment, the local wave length decreased with the axial distance of the condensing surface and the average wave length decreased with increasing inlet vapor velocity, while the wave speed increased with increasing vapor velocity. The heat transfer measurements are reliable. And, the ultrasonic technique was effective for measuring the condensate film thickness when the surface was smooth or had waves of small amplitude. Author

N92-19282# Arizona State Univ., Tempe.
WAVE-TURBULENCE INTERACTION AT AN INVERSION LAYER Final Report, 24 Jun. - 23 Oct. 1991
H. J. Fernando and D. L. Boyer Dec. 1991 11 p
(Contract DAAL03-91-G-0218)
(AD-A244109; ARO-29188.1-GS) Avail: NTIS HC/MF A03 CSCL 21/4

The interaction of turbulence and stratification in a three layer system and the nature of shear-free turbulence near sharp interfaces were investigated. The structure of turbulence within and near inversion layers as well as the motion within the interior of an outer stratified layer are of interest in understanding the communication between stratified and turbulent layers. Such an understanding is imperative in predicting the penetration of a turbulent layer into a contiguous stratified region (entrainment phenomena) and the dispersion of species in the turbulent layer. A stunning example in this context is the fluid motion in the lower atmosphere generated by convective turbulence. Here the stratification consists of three layers; the bottom layer near the surface is well mixed by convective turbulence and the outer weakly stratified layer is separated from the bottom layer by a strong, stable, somewhat thin layer called the inversion layer. The height of the bottom layer is referred to as the mixing height. GRA

N92-19294# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes de Recherches en Aerothermodynamique.
A DEFICIT APPROACH TO THREE DIMENSIONAL INCOMPRESSIBLE FLOWS Final Report [APPROCHE DEFICITAIRE POUR ECOULEMENTS TRIDIMENSIONNELS INCOMPRESSIBLES. RAPPORT FINAL]
B. Aupoix and O. Rouzaud Apr. 1991 32 p In FRENCH
(Contract DRET-89-002-057)
(CERT-RF-39/5025-36; ETN-92-90870) Avail: NTIS HC/MF A03

A deficit approach originally developed for hypersonic laminar limit layers in two dimensional flows is extended to three dimensional incompressible flows and laminar and turbulent flows. The extension of the approach is straightforward for laminar flow, but requires a totally different approach for turbulent flow. Modifications carried out to the approach in order to handle turbulent flows are outlined. The deficit equations are included in a three dimensional boundary layer calculation program. Results from previous two dimensional flow studies validate the inclusion of these equations in the calculation program. ESA

N92-19348# Metraflu, Ecully (France).
ANISOTROPIC SPECTRAL MODELING OF TURBULENT FLOWS ASSOCIATED WITH COUPLED DEFORMATION AND ROTATION EFFECTS Final Summary Report [MODELISATION SPECTRALE ANISOTROPE D'ELEMENTS D'ECOULEMENTS TURBULENTS EN PRESENCE D'EFFETS COUPLES DE DEFORMATION ET DE ROTATION. RAPPORT DE SYNTHESE FINALL]
Claude Cambon Mar. 1991 35 p In FRENCH
(Contract DRET-88-351)
(ETN-92-90866) Avail: NTIS HC/MF A03

The anisotropic spectral model and calculation code are presented. Validation of the model is described. The linear terms are resolved by quasi-implicit methods by treating the problem of associated stability at the simplest and most general level. The terms associated with the nonlinear interactions are closed by a three-dimensional model on which harmonic angular decomposition is carried out. The seven real spherical coefficients of the two three-dimensional components T(e) and T(z) of the spectral tensor are determined. ESA

N92-19349# Metraflu, Ecully (France).
INHOMOGENEOUS TURBULENCE BEYOND SPECTRAL EQUILIBRIA: AERONAUTICAL APPLICATIONS Final Report [TURBULENCE NON-HOMOGENE HORS D'EQUILIBRE SPECTRAL: APPLICATIONS AERONAUTIQUES. RAPPORT FINAL]
Jean-Pierre Bertoglio and Marc Michard Dec. 1990 93 p In FRENCH
(Contract DRET-88-351)
(ETN-92-90867) Avail: NTIS HC/MF A05

A spectral model of inhomogeneous turbulence is proposed. The simplified model is based on closure at two homogeneous points. The terms of inhomogeneous transport are expressed by means of a model based on one point of closure. The model is included in a finite element calculation code. Applications of the method to enclosed flow in aeronautical situations are proposed. Direct numerical simulation is carried out as a means of validating the method. The feasibility of a reference experiment is considered. Initial application to aeronautic calculations is performed. ESA

N92-19386# PEDA Corp., Palo Alto, CA.
ACCURATE, PRODUCTIVE AERODYNAMIC SIMULATION ON PATCHED MESH SYSTEMS Final Report, 1 Oct. 1986 - 30 Sep. 1991
Charles Lombard 18 Oct. 1991 52 p
(Contract F49620-85-C-0081)
(AD-A243977; AFOSR-91-0975TR) Avail: NTIS HC/MF A04 CSCL 20/4

In the fifth and final year of the program the research has completed defining data structures, object based programming style, and tools for a new flexible approach to scientific programming and problem solving. Problems of program complexity associated with changing models and physics as well as with joined and disjoint multiple independent patched mesh domain decompositions for treating complex geometries and resolving captured flow structures can by systematically organized within the context of the directed graph programming concept being explored. Problems and parts of problems having geometric connectivity or its analogs such as association, hierarchy or precedence relationships are naturally exhibited and easily debugged or modified in the graph. The solution of problems is literally to traverse the graphs. For the emerging prototype aerodynamic simulation facility, the graphs which are to control grid generation Navier-Stokes solution procedures, and scientific graphics are to be constructed with a graphical editor hosted in high performance graphics workstations. The efficient global data structure for the system is a set of large linear arrays in which the data and parameterization associated with the independent

quadrilateral blocks of mesh are sequentially stacked. The directed graph is to control procedures that point to and operate on the data structure. GRA

N92-19446# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
HIGH-RESOLUTION TVD SCHEMES FOR THE ANALYSIS OF: 1: INVISCID SUPERSONIC AND TRANSONIC FLOWS. 2: VISCOUS FLOWS WITH SHOCK-INDUCED SEPARATION AND HEAT TRANSFER Ph.D. Thesis
Mark A. Driver Dec. 1991 167 p
(AD-A243913) Avail: NTIS HC/MF A08 CSCL 20/4

Application of TVD schemes to both inviscid and viscous flows is considered. The mathematical and physical bases of TVD schemes are discussed. First and second-order accurate TVD schemes and a second-order accurate Lax-Wendroff scheme are used to compute solutions to the Riemann problem in order to investigate the capability of each to resolve shocks, rarefactions, and contact surfaces. Second-order finite-volume and finite-difference TVD schemes are used to obtain solutions to inviscid supersonic and transonic cascade flow problems. TVD schemes are shown to be superior to the Lax-Wendroff family of schemes for both transient and steady-state computations. TVD methodology is extended to solution of viscous flow problems. A first-order time accurate, second-order space accurate algorithm is contrasted against a second-order time and space accurate algorithm for solution of the viscous Burgers' equation. Necessity of using the fully second-order accurate algorithm at low Reynolds numbers is shown. Solutions are computed to problems of laminar shock-boundary-layer interaction and unsteady, laminar, shock-induced heat transfer using the new algorithms. These algorithms provide the capability to accurately predict separation, reattachment, and pressure and skin friction profiles for shock-boundary-layer interaction. Extremely accurate comparison with theory and experiment is also evident for the unsteady shock-induced head transfer problem. GRA

N92-19475# International Centre for Theoretical Physics, Trieste (Italy).
ON PERMANENT CAPILLAR-HEAVY WAVES IN INFINITE CHANNELS
N. Moussa Aug. 1991 13 p
(DE92-603745; IC-91/229) Avail: NTIS HC/MF A03

This work is based on the constructive existence proof of solutions of a comprehensive class of non-linear free boundary value problems of plane hydrodynamics. A general computational method for numerically constructing the solutions is given. The case of permanent capillar-heavy waves in infinite channels will be considered. DOE

N92-19488# Technische Univ., Delft (Netherlands).
LAMINAR AND TURBULENT CONVECTION IN CAVITIES: NUMERICAL MODELING AND EXPERIMENTAL VALIDATION Ph.D. Thesis
Adriaan Marinus Lankhorst 1991 248 p Sponsored by Netherlands Agency for Energy and the Environment
(ETN-92-90881) Avail: NTIS HC/MF A11

A numerical and experimental study of natural convection in rectangular enclosures in a large range of Rayleigh numbers up to 10(exp 12) is presented. The equations and boundary conditions that govern the turbulent three dimensional natural convective flow are presented. Some approximations and their restrictions are discussed. Closely related to these approximations are the characteristic velocity and length scales for the different Rayleigh numbers. Temperature and heat transfer measurements by holographic interferometry and velocity and velocity fluctuation measurements by means of laser Doppler anemometry are described. The numerical method used to solve the governing equations is described with special attention given to convergence and stability. The results of the numerical simulations are reported: results for air and water as the working fluid are classified into four Rayleigh number ranges; for various Rayleigh numbers, results of grid refinement tests are discussed indicating the accuracy of the numerical method; the influence of the upper and lower horizontal walls on the vertical wall heat transfer is presented; computations in three dimensional enclosures provide information on the importance of lateral sidewall effects; results for inclined cavities are presented. The model was used to calculate two dimensional natural convection in a room. ESA

N92-19490# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
WP 4b COMPRESSIBLE FLOW SIMULATION: INFORMATION SYSTEM FOR FLOW SIMULATION BASED ON THE NAVIER-STOKES EQUATION (ISNaS). REQUIREMENTS GRID GENERATION FOR THE ISNaS COMPRESSIBLE FLOW SOLVER
M. E. S. Vogels 5 Apr. 1988 22 p
(NLR-TR-88103-U; ISNaS-88-05-028; ETN-92-90953) Avail: NTIS HC/MF A03

ISNaS will eventally consist of the subsystems geometry handling, grid generation, flow solver, and post processing (e.g., flow visualization). The requirements for subsystem grid generation for the ISNaS project flow solver are given. Since the development of the subsystem grid generation is not part of the ISNaS project, and existing subsystems will be used 'as is', restriction was made to the requirements essential for the generation of a suitable grid for viscous compressible flow simulation. ESA

N92-19512# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
PROCEEDINGS OF THE PRINCETON WORKSHOP ON NEW APPROACHES TO EXPERIMENTAL TURBULENCE RESEARCH Final Report, 15 Aug. 1990 - 14 Feb. 1991
Alexander J. Smits 24 Jun. 1991 159 p Workshop held in Princeton, NJ, 5-7 Sep. 1990
(Grant AF-AFOSR-0315-90; AF Proj. 2307)
(AD-A243989; MAE-1924; AFOSR-91-0990TR) Avail: NTIS HC/MF A08 CSCL 20/4

The focus of this workshop was to address some issues facing the experimental turbulence research community, such as the question of its relevance to advances in fluid mechanics, the role of computers and instrumentation, finding sources, education, and faculty development. The major concerns were identified, and discussions were had to develop a strategy to guide our future activities. About 50 research workers in turbulence attended, from all aspects of turbulence research, over a period of two and a half days. GRA

N92-19515# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
ARTIFICIAL BOUNDARY CONDITIONS FOR WAVE EQUATIONS
Peter Wilde Oct. 1991 18 p
(Contract STU-88-00397P)
(FFA-TN-1991-33; ETN-92-90807) Avail: NTIS HC/MF A03

Artificial boundary conditions for the dispersive as well as for the dissipative wave equation are discussed. Existence and uniqueness results for the resulting boundary problems and a numerical method to solve these problems are given. ESA

N92-19523 California Inst. of Tech., Pasadena.
EFFECTS OF BOUNDARIES ON RAYLEIGH-BENARD CONVECTION Ph.D. Thesis
Yih-Yuh Chen 1991 93 p
Avail: Univ. Microfilms Order No. DA9137215

The effects of boundary conditions on the linear stability of finite cell pure fluid Rayleigh-Benard convection are investigated via a variational formalism and a perturbative approach. Some general properties of the critical Rayleigh number R(sub c) with respect to change of boundary conditions or system size are derived. I argue that R(sub c) differs from its finite cell limit by an amount that is inversely proportional to the square of the system size, and that the fluid variables must become vanishingly small near the sidewall when compared to their bulk values, thus, generalizing the known results derivable from the amplitude

equation approach for a two-dimensional problem. It is also shown that the reaction-diffusion models of spatial pattern forming systems in developmental biology can be thought of as a special case of the convection problem. I also show that, as far as the onset stability is concerned, one can replace the sidewall of a convection cell by a mathematically simpler homogeneous boundary condition which still retains the basic physics involved. Dissert. Abstr.

N92-19538 California Inst. of Tech., Pasadena.
AN ANALYTICAL AND COMPUTATIONAL INVESTIGATION OF SHOCK-INDUCED VORTICAL FLOWS WITH APPLICATIONS TO SUPERSONIC COMBUSTION Ph.D. Thesis
Joseph Yang 1991 365 p
Avail: Univ. Microfilms Order No. DA9137305

The motivation for study of shock-induced vortical flows is the problem of achieving rapid and efficient mixing of fuel and oxidizer in a supersonic combustion ramjet engine. In particular, the interaction of a shock wave with a jet of light gas generates vorticity which can be used to stir and mix the fluids. This investigation consists of two parts. The first part is a characterization of the basic fluid mechanics of the interaction. The canonical problem is a shock wave passing over a circular light gas inhomogeneity to deposit vorticity around the perimeter. As time goes on, the structure rolls up into a pair of counter-rotating vortices. This flow is simulated numerically by integrating the governing equations subject to specified initial conditions. From first principles, analytical models are developed to predict the circulation, spacing, and characteristic time for development as a function of initial conditions. From perturbation analysis, another model is developed to predict the vortex pair velocity as a function of the geometrical parameters, vortex size/vortex spacing, and vortex spacing/channel spacing. The second part is an investigation of mixing efficiencies for various initial configurations. In the canonical flow, stabilization of the vortex pair eventually impairs the mixing. Various initial configurations are considered with the goal of improving the mixing. The mixing is quantified by an asymptotic stretching rate of a material element. Single jet shape perturbations yield little improvement in mixing, but multiple jet arrays do, especially through the phenomenon of entrainment. Another way to improve the mixing is to hit a vortex pair with a reflected shock. Finally, a mathematical correspondence is exhibited between the unsteady 2-D flows considered here and the corresponding 3-D steady flows that may be more typical of real combustor designs. Dissert. Abstr.

N92-19539 Oregon Univ., Eugene.
STABILITY OF TAYLOR-COUETTE FLOW SUBJECTED TO A CORIOLIS FORCE Ph.D. Thesis
Richard Jay Wiener 1991 138 p
Avail: Univ. Microfilms Order No. DA9137384

The primary instability in Taylor-Couette flow (the flow of fluid between concentric rotating cylinders) subjected to a nonaxisymmetric Coriolis force is studied experimentally and theoretically. In the experiment, the Couette apparatus is mounted horizontally on a turntable so that the axis of the cylinders is orthogonal to the rotation vector of the turntable. The interaction of the turntable rotation with circular Couette flow yields a Coriolis force whose strength depends on azimuthal position about the axis of the cylinders (i.e. the force is nonaxisymmetric). Kalliroscope flow visualization and an infrared reflectance signal are used as the means of detection. It is found experimentally that the Coriolis force stabilizes the fluid against the onset of Taylor vortices and alters the velocity fields, both above and below the transition from the base flow. At small dimensionless turntable frequencies (omega), the primary instability leads to time-independent, nonaxisymmetric Taylor vortices which are tilted out of the plane normal to the cylinders' common axis. At larger omega, there is a direct transition to turbulence. The base flow and its stability are calculated perturbatively to order omega exp 2. A generalized linear eigenvalue problem is posed for the stability calculation. The first-order correction to the eigenvalue is found to be zero in accordance with the system's symmetry. The second-order correction is calculated using the zeroth- and first-order eigenfunctions and a suitably defined inner-product. The calculation yields an eigenvalue in quantitative agreement with experimental results. The analysis also indicates that an axisymmetric eigenmode is the first to become unstable, but the Coriolis force adds first-order nonaxisymmetric corrections to this mode. Thus, the primary instability leads to time-independent, nonaxisymmetric Taylor vortices. The range in omega for the validity of the theoretical analysis decreases as the ratio of the inner- to outer-cyclinder approaches one. Dissert. Abstr.

N92-19541# Wright Lab., Wright-Patterson AFB, OH.
PARTICLE RELAXATION DISTANCES DOWNSTREAM OF NORMAL AND OBLIQUE SHOCKS
Mark S. Maurice 10 Dec. 1991 13 p
(AF Proj. 2404)
(AD-A244085; WL-TM-91-328) Avail: NTIS HC/MF A03 CSCL 20/4

A particle equation of motion is coupled with ideal, inviscid shock theory to predict the dynamic velocity bias of laser velocimetry seed within these flow regions. Dimensionless graphs of relaxation distances are presented as an aid for experimental design and data evaluation efforts. GRA

N92-19552 California Inst. of Tech., Pasadena.
MIXING IN HIGH SCHMIDT NUMBER TURBULENT JETS Ph.D. Thesis
Paul Lewis Miller 1991 142 p
Avail: Univ. Microfilms Order No. DA9137266

An experimental investigation of the passive scalar (species concentration) field in the far-field of round, axisymmetric, high Schmidt number (liquid phase), turbulent jets issuing into a quiescent reservoir, by means of a quantitative laser-induced fluorescence technique is presented. Single-point concentration measurements are made on the jet centerline, at axial locations from 100 to 305 nozzle diameters downstream, and Reynolds numbers of 3,000 to 102,000, yielding data with a resolved temporal dynamic range up to 2.5 x 10 exp 5, and capturing as many as 504 large-scale structure passages. Long-time statistics of the jet concentration are found to converge slowly. Between 100 and 300 large-scale structure passages are required to reduce the uncertainty in the mean to 1 percent, or so. The behavior of the jet varies with Reynolds number. The centerline concentration pdf's become taller and narrower with increasing Re, and the normalized concentration variances correspondingly decrease with Re. The concentration power spectra also evolve with Re. The behavior of the spectral slopes is examined. In the viscous region, the power spectra exhibit log-normal behavior, over a range of scales exceeding a factor of 40, in some cases. The frequency of the beginning of this log-normal range scales like Re exp 3/4 (Kolmogorov scaling). Mixing in the far-field is found to be susceptible to initial conditions. Disturbances in the jet plenum fluid and near the nozzle exit strongly influence the scalar variance, with larger disturbances causing larger variances. The plenum/nozzle geometry also influences the variance. These effects of initial conditions persist for hundreds of diameters from the nozzle exit, over hundreds of large scales. Mixing in these jets differs from gas-phase, order unity Sc, jet mixing. At low to moderate Re, the higher Sc jet is less well mixed. The difference is less pronounced at higher Re. Flame length estimates imply either an increase in entrainment and/or an increase in molecular mixing, with increasing Re. Dissert. Abstr.

N92-19617 Illinois Univ., Urbana-Champaign.
NUMERICAL MODELING AND SIMULATION OF COMPRESSIBLE REACTING TURBULENT SHEAR LAYERS Ph.D. Thesis
Ronald Frederick Burr 1991 349 p
Avail: Univ. Microfilms Order No. DA9136558

Numerical modeling and simulation of compressible reacting turbulent shear layers are considered. Improved turbulent transport models for compressible shear layers are presented and validated with detailed experimental data. The new compressible models are one-equation and two-equation algebraic Reynolds stress

models (ASMs), which account for variations in the anisotropy of the normal stresses through change of the pressure-strain terms of the Reynolds stress transport equations. The compressible ASMs correctly predict the experimentally observed increase in turbulence anisotropy with increasing compressibility, as well as the reduction in the normalized shear layer growth rate. Numerical simulations of temporally evolving compressible and reacting shear layers are performed. The results are examined in terms of steady state shear layer modeling techniques. Results from the simulations are consistent with recent experimental data and further support the proposed compressibility changes to the pressure strain modeling. It is shown that standard incompressible pressure strain models overestimate the contribution of these terms under compressible conditions. Dissert. Abstr.

N92-19627 Cincinnati Univ., OH.
A PRIMITIVE VARIABLE METHOD FOR THE SOLUTION OF EXTERNAL AND INTERNAL INCOMPRESSIBLE FLOW-FIELDS Ph.D. Thesis
Fotis Sotiropoulos 1991 259 p
Avail: Univ. Microfilms Order No. DA9200510

A primitive variable method for the solution of the steady, three-dimensional, incompressible Euler and Reynolds averaged Navier-Stokes equations in generalized curvilinear coordinates is developed. The governing equations are discretized on a nonstaggered computational grid and the discrete continuity equation is replaced by an optimized discrete pressure-Poisson equation. The accuracy of the conventional pressure-Poisson formulations on two-dimensional, cartesian, nonstaggered computational grids is carefully studied. It is shown that the discretized continuum pressure equation produces a smooth pressure field at the cost of introducing, implicitly, an artificial mass source term in the discrete continuity equation. An alternative approach for directly deriving a discrete pressure equation, starting from the discrete momentum and continuity equation, is also considered. This later approach satisfies the discrete continuity equation to machine zero but it does not guarantee, in general, the existence of a smooth and physically meaningful solution for the pressure. The proposed pressure-Poisson formulation is appropriately extended to generalized curvilinear coordinates. Dissert. Abstr.

N92-19673*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ANALYSIS OF AN RNG BASED TURBULENCE MODEL FOR SEPARATED FLOWS
C. G. Speziale and S. Thangam (Stevens Inst. of Tech., Hoboken, NJ.) Jan. 1992 19 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189600; NAS 1.26:189600; ICASE-92-3) Avail: NTIS HC/MF A03 CSCL 20D

A two-equation turbulence model of the K-epsilon type was recently derived by using Renormalization Group (RNG) methods. It was later reported that this RNG based model yields substantially better predictions than the standard K-epsilon model for turbulent flow over a backward facing step - a standard test case used to benchmark the performance of turbulence models in separated flows. The improvements obtained from the RNG K-epsilon model were attributed to the better treatment of near wall turbulence effects. In contrast to these earlier claims, it is shown in this paper that the original version of the RNG K-epsilon model substantially underpredicts the reattachment point in the backstep problem. This is a deficiency that is traced to the modeling of the production of dissipation term. However, with the most recent improvements in the RNG K-epsilon model, excellent results for the backstep problem are now obtained. Author

N92-19681# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace Science.
VISCOUS FLUX LIMITERS
E. F. Toro Sep. 1991 11 p Presented at the 9th GAMM Conference on Numerical Methods of Fluid Mechanics, Lausanne, Switzerland, Sep. 1991
(Cranfield-Aero-9115; ISBN-1-871564-34-4; ETN-92-91053)
Avail: NTIS HC/MF A03; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC 8 sterling pounds

Numerical Viscosity Functions (NVFs) for use with Riemann problem based shock capturing methods as applied to viscous flows are presented. In particular, viscous flux limiters are derived. The analysis pertains to a linear convection diffusion model equation. The NVFs combine the physical viscosity, the role of which is maximized, with numerical viscosity, whose role is minimized, to capture TVD (Total Variation Diminishing) solutions to viscous flows. ESA

N92-19763*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
DEVELOPMENT OF ITERATIVE TECHNIQUES FOR THE SOLUTION OF UNSTEADY COMPRESSIBLE VISCOUS FLOWS Progress Report, 14 Aug. 1991 - 13 Feb. 1992
Lakshmi N. Sankar and Duane Hixon Feb. 1992 28 p
(Grant NAG1-1217)
(NASA-CR-190031; NAS 1.26:190031) Avail: NTIS HC/MF A03 CSCL 20D

The development of efficient iterative solution methods for the numerical solution of two- and three-dimensional compressible Navier-Stokes equations is discussed. Iterative time marching methods have several advantages over classical multi-step explicit time marching schemes, and non-iterative implicit time marching schemes. Iterative schemes have better stability characteristics than non-iterative explicit and implicit schemes. In this work, another approach based on the classical conjugate gradient method, known as the Generalized Minimum Residual (GMRES) algorithm is investigated. The GMRES algorithm has been used in the past by a number of researchers for solving steady viscous and inviscid flow problems. Here, we investigate the suitability of this algorithm for solving the system of non-linear equations that arise in unsteady Navier-Stokes solvers at each time step. D.R.D.

N92-19801# Calspan-Buffalo Univ. Research Center, NY.
INVESTIGATION OF UNSTEADY FLOW IN AN ANNULAR CASCADE Final Report, Jul. 1987 - Oct. 1991
William K. George, Dale B. Taulbee, and Richard L. LeBoeuf 1 Oct. 1991 112 p
(Contract F49620-87-C-0053)
(AD-A244033; AFOSR-91-0953TR) Avail: NTIS HC/MF A06 CSCL 20/4

The proper orthogonal decomposition (POD) was used to test the hypothesis that there exists a set of functions which characterize a turbine stator exit flowfield and whose dynamics may explain some of the complex behavior in downstream blade rows. The decomposition was applied to three component triple-wire probe measurements of a large-scale annular stator model exit flowfield. This study represents the first application of the orthogonal decomposition to directly measured three component data, and one of the first applications to an applied engineering flow. The full three-component cross-spectral tensor was produced from simultaneous multipoint triple-wire probe measurements. The measurements were taken across one stator pitch, at the passage midspan, 10 percent axial chord downstream of the stator trailing edge. The resulting 1089 cross-spectral estimates were then decomposed to obtain the eigenspectra and eigenmodes of the midspan flowfield. In addition, the POD was applied to two subdomains of the passage flowfield in order to increase the convergence rate of the energy representation. The two subdomains were taken to be the wake and outer flow region because of the large difference in scales between those regions. The wake spanned approximately 20 percent of the statorpitch at the measurement plane. Large distinct low frequency peaks (below 200 Hz) were found in many of the eigenmodes although not consistently at the same frequencies. GRA

N92-19823# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
VERTICAL INTEGRATION OF 3-PHASE FLOW EQUATIONS FOR ANALYSIS OF LIGHT HYDROCARBON PLUME MOVEMENT
J. C. Parker and R. J. Lenhard 1989 22 p Submitted for publication Sponsored in part by Robert S. Kerr Environmental Research Lab., Ada, OK
(PB91-242487; EPA/600/J-89/545) Copyright Avail: NTIS HC/MF A03 CSCL 20D

Groundwater contamination due to surface spills or subsurface leakage of hydrocarbon fuels, organic solvents, and other immiscible organic liquids is a widespread problem. Numerical models for phase-separated hydrocarbon migration in the vadose zone and groundwater have been presented recently by various researchers. Most analyses have been restricted to consideration of two-dimensional domains involving a vertical slice through unsaturated and/or saturated zones. Here, a mathematical model is derived for areal flow of water and light hydrocarbon in the presence of gas at atmospheric pressure. Vertical integration of the governing three-dimensional, three-phase flow equations is performed under the assumption of local vertical equilibrium to reduce the dimensionality of the problem to two orthogonal horizontal directions. Independent variables in the coupled water and hydrocarbon areal flow equations are specified as the evaluation of zero gauge hydrocarbon pressure (air-oil table) and the elevation of zero gauge water pressure (air-water table). Constitutive relations required in the areal flow model are vertically integrated fluid saturations and vertically integrated fluid conductivities as functions of air-oil and air-water table elevations. Closed-form expressions for the vertically integrated constitutive relations are derived based on a three-phase extension of the Brooks-Corey saturation-capillary pressure function. Reduction in dimensionality combined with diminished nonlinearity, makes the vertically integrated water and hydrocarbon model an efficient formulation for analyzing field-scale problems involving hydrocarbon spreading or recovery under conditions for which the vertical equilibrium assumption is expected to be a satisfactory approximation. Author

N92-19844*# Analytical Services and Materials, Inc., Hampton, VA.
SECONDARY INSTABILITY OF HIGH-SPEED FLOWS AND THE INFLUENCE OF WALL COOLING AND SUCTION
Nabil M. El-Hady Washington NASA. Langley Research Center Feb. 1992 58 p
(Contract NAS1-18599)
(NASA-CR-4427; NAS 1.26:4427) Avail: NTIS HC/MF A04 CSCL 20D

The periodic streamwise modulation of the supersonic and hypersonic boundary layers by a two dimensional first mode or second mode wave makes the resulting base flow susceptible to a broadband spanwise-periodic three dimensional type of instability. The principal parametric resonance of this instability (subharmonic) was analyzed using Floquet theory. The effect of Mach number and the effectiveness of wall cooling or wall suction in controlling the onset, the growth rate, and the vortical nature of the subharmonic secondary instability are assessed for both a first mode and a second mode primary wave. Results indicate that the secondary subharmonic instability of the insulated wall boundary layer is weakened as Mach number increases. Cooling of the wall destabilizes the secondary subharmonic of a second mode primary wave, but stabilizes it when the primary wave is a first mode. Suction stabilizes the secondary subharmonic at all Mach numbers. Author

N92-19876# Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
BOUNDARY CONDITIONS FOR GRANULAR FLOWS AT RANDOMLY FLUCTUATING BUMPY BOUNDARIES
M. W. Richman 1991 13 p Presented at the 2nd US-Japan Seminar on Micromechanics of Granular Materials, Syracuse, NY, 4-10 Aug. 1991
(Contract DE-AC22-91PC-90185)
(DE92-004496; CONF-9108127-3) Avail: NTIS HC/MF A03

In this paper we focus attention on the interactions between rapid flows of identical, smooth spheres that interact with bumpy boundaries through inelastic collisions. The boundaries translate with specified mean velocities, and deviate about the mean with specified fluctuation velocities. Based upon Maxwellian velocity distribution functions that describe the velocities of both the flow particles and boundaries, we calculate the rates at which linear momentum and kinetic energy are exchanged between the two. Using these exchange rates, we write down conditions that ensure that both momentum and energy are balanced at bumpy boundaries. Finally, we employ a constitutive theory that is consistent with these conditions to calculate the granular temperature and solid fraction profiles within a granular material confined between two parallel, bumpy surfaces that randomly fluctuate about zero mean velocity. DOE

N92-19903# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE THEORETICAL STUDY AND FINITE-ELEMENT APPROXIMATION OF THE MULTIDIMENSIONAL, MULTISPECIES, HYPERBOLIC SYSTEM OF GAS DYNAMICS Ph.D. Thesis - Paris VI Univ.
Jean-Pierre Croisille 1991 190 p In FRENCH; ENGLISH summary Translation was announced as ESA-TT-1275 Original contains color illustrations
(ONERA-NT-1991-3; ISSN-0078-3781; ETN-92-91024) Avail: NTIS HC/MF A09

Some aspects of the change of variables in thermodynamics (extensive, intensive variables) and in gas dynamics (conservative, entropic variables) are considered. The system of compressible Euler equations of gas mixtures is described from the thermodynamics point of view with the state equation in general form for pressure. The K-diagonalizable system includes both the symmetric and kinetic aspects of the Euler equations in a unique formalism. The flux- splitting concept is generalized to kinetic flux-splitting using the sign of the eigenvalues. A finite-element method of the discontinuous Galerkin type, which uses both entropic variables and kinetic flux-splitting, is proposed. Some properties of the method are identified. The case of the Friedrichs systems is also considered. An original, totally nonstructured mesh refinement method is implemented in the two-dimensional case. ESA

N92-19916# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics and Fluid Dynamics.
SOME ASPECTS OF SHOCK CAPTURING METHODS FOR GAS DYNAMICS
E. F. Toro Aug. 1991 55 p Presented at the Computational Fluid Dynamics Workshop, Sendai, Japan, Jul. 1991
(Cranfield-Aero-9112; ISBN-1-871564-32-8; ETN-92-90755)
Avail: NTIS HC/MF A04; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford, MK43 OAL, England, HC 8 sterling pounds

Three topics on modern shock capturing methods for the time dependent Euler equations of gas dynamics are addressed. The Weighted Average Flux (WAF) Method, one of the several Riemann problem based shock capturing methods, is presented. The Riemann problem is addressed. An efficient exact Riemann solver, a robust noniterative Riemann solver based on the behavior of the exact solver, and an improved version of the Harten-Lax-van Leer Riemann solver are presented. A very simple linearized Riemann solver is presented together with a Riemann solver adaptation procedure. A Riemann solver adaptation procedure that has proved successful is presented. Applications of the WAF method with the various Riemann solvers are presented. ESA

N92-19931# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PERFORATED CARBON/EPOXY PLATES DAMAGE MODELING FOR QUASI-STATIC BIAXIAL LOADING Ph.D. Thesis - Ecole Centrale des Arts et Manufactures
Thierry Jeggy 1991 301 p In FRENCH; ENGLISH summary
Translation was announced as ESA-TT-1273
(ONERA-NT-1991-1; ISSN-0078-3781; ETN-92-90684) Avail: NTIS HC/MF A14

Damage propagation in graphite/epoxy notched plates subjected to biaxial monotonic loadings is studied. The biaxial state of stress is induced by planar tensile/tensile loading in two perpendicular directions. The damage is evaluated by means of penetrant enhanced X-ray radiography. On the basis of preliminary experimental analysis, two theoretical models for transverse cracking and fiber breakage are developed. Comparisons between experiments and calculations are presented for different stacking sequences, tensile curves, and damage representations. ESA

N92-19932# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FUNDAMENTAL STUDY OF SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION WITH PASSIVE CONTROL IN TRANSONIC FLOW Ph.D. Thesis - Paris Univ. VI
Reynald Bur 1991 238 p In FRENCH; ENGLISH summary
Report will also be announced as translation (ESA-TT-1278)
(ONERA-NT-1991-9; ISSN-0078-3781; ETN-92-90754) Avail: NTIS HC/MF A11

Different techniques used to control the interaction between a shock wave and a turbulent boundary layer show that passive control tends to improve profile performance at transonic velocities. An analysis of an interaction subjected to passive control was performed in a transonic channel, taking into account the following parameters: shock location with respect to the cavity, porosity, hole diameter of the perforated plate, and cavity depth. The flow was qualified by means of schlieren visualizations, wall pressure measurements, and probing with a two dimensional laser velocimetry system. A momentum balance realized in the control region was allowed to select configurations where frictional drag was reduced compared to the reference case without control. The theoretical study is based on a boundary layer type approach using the first order Prandtl equations. The turbulent field was computed considering equilibrium and nonequilibrium models. Passive control influences take place both in the mean field through the existence of transpiration velocity giving a boundary layer condition not equal to zero at the porous wall and in the turbulent field. This effect is represented by introduction of a modified Van Driest damping function. Solutions to these modifications are proposed. A comparison with experimental results, gives information about the validity of turbulence models and modifications which consider an effect of control. ESA

N92-19968# Lowell Univ., MA. Dept. of Electrical Engineering.
STABILITY AND HEAT TRANSFER IN TIME-MODULATED FLOWS
C. Thompson 1991 6 p
(Contract DE-FG02-91ER-14179)
(DE92-007034; DOE/ER-14179/1) Avail: NTIS HC/MF A02

In May 1991, DOE awarded grant DE-FG02-91ER-14179 for the investigation of stability and heat transfer in time-modulated flows. The general objectives of the research were (1) to demonstrate and quantify theoretically and experimentally the physics of modulational instability; (2) to exhibit experimentally and describe theoretically the sensitivity of modulational instability to harmonic content of the basic state; (3) to model the influence of mean-flow on modulational instability: (4) to examine practical design implications of the results with particular attention given to heat transfer. During the last six months, the emphasis of the research has been placed on objective 1 as it relates to the fundamental physical mechanisms, experiment design, and techniques required for the demonstration and description of the modulational instability. DOE

N92-19976# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
RESOLUTION OF THE EULER EQUATIONS APPLIED TO A HELICOPTER ROTOR IN FORWARD FLIGHT Final Summary Report [RESOLUTION DES EQUATIONS D'EULER APPLIQUEE A UN ROTOR D'HELICOPTERE EN VOL D'AVANCEMENT. RAPPORT DE SYNTHESE FINAL]
J. Sides and J. C. Boniface Aug. 1991 58 p In FRENCH
(Contract DRET-89-34-001)
(ONERA-RSF-2/3731-AY-004A; ETN-92-91081) Avail: NTIS HC/MF A04

The simulation of three-dimensional compressible flow around a helicopter rotor in steady flight was studied by solving the Euler equations. The centered implicit method without viscosity is extended for the wing problem and then for the isolated blade and multiblade rotor problem in stationary flight. For the wing problem, an effective development strategy of the implicit phase of the method is studied and implemented. Importance is attached to the construction of a mesh adpated to each application envisaged in the single domain computation method. First results for rotor models are presented and analyzed. ESA

N92-20007# Laval Univ. (Quebec). Faculte de Sciences et de Genie.
A FINITE ELEMENT MODEL ESTIMATION OF TURBULENCE SIMULATION Ph.D. Thesis [APPROXIMATION PAR ELEMENTS FINIS D'UN MODELE DE SIMULATION DE LA TURBULENCE]
Hassan Manouzi Feb. 1986 207 p In FRENCH
(CTN-92-60396) Avail: NTIS HC/MF A10

A numerical model for the resolution of Navier-Stokes equations in a turbulent flow regime by a finite element method has been developed. Even with a rather rough discretization of the solution domain, the short term flow between two parallel planes is well predicted. Results obtained in comparison with other numeric methods or experimental results are good. In particular, the method is very well behaved in the treatment of the boundary layer near the wall. The use of a linear-log finite element technique attenuated the abrupt variations of flow properties in this region. The method is relatively robust in the application of Newton - Gauss - Siedel method and use of this technique resulted quickly in convergence. The calculation of friction rate employs a logarithmic law in each iteration of the Newton method on the Navier-Stokes equations. For each iteration, a Newton method is used to solve both a linear problem for the kinetic energy of turbulence (k), and a nonlinear problem for its rate dissipation (eta). A maximum error of the order of 10 to the minus 5th power for eta is obtained in three of four iterations and in the order of 10 to the minus 4th power for the friction rate is obtained in 7 or 8 iterations. The numeric technique adopted for the integration of the model equations may be considered as operational in view of the results obtained. CISTI

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-19027# California Univ., Berkeley. Lawrence Berkeley Lab.
IMPROVED IONIZATION CHAMBER DOSIMETER Patent Application
T. R. Renner, inventor (to DOE), M. A. Nyman, inventor (to DOE), and R. Stradtner, inventor (to DOE) 16 Apr. 1990 8 p
(Contract DE-AC03-76SF-00098)
(DE92-003876; US-Patent-Appl-SN-509121; Patents-US-A7509121) Avail: NTIS HC/MF A02

The present invention relates to a method for fabricating an

ionization chamber dosimeter for measuring charges produced by ionizing radiation. The dosimeter collecting array is of a type that utilizes plural discrete elements formed on a uniform collecting surface. The fabrication process includes forming a thin insulating layer over an aperture in a frame having surfaces, forming a predetermined pattern of through holes in the layer, plating both surfaces of the layer, and simultaneously tilting and rotating the frame for uniform plate-through of the holes between surfaces. Aligned masking and patterned etching of the surfaces provides interconnects between the through holes and copper leads attached to external circuitry. DOE

N92-19107*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTIWAVELENGTH PYROMETRY FOR NONGRAY SURFACES IN THE PRESENCE OF INTERFERING RADIATION
Daniel Ng Feb. 1992 10 p
(NASA-TM-105286; E-6617; NAS 1.15:105286) Avail: NTIS HC/MF A02 CSCL 14B

A NASA developed multiwavelength pyrometry technique for nongray surfaces was extended to also measure surface temperature in the presence of interfering radiation. This radiation is produced by heat lamps used to raise the temperature of the surface. The necessary instruments are a spectral radiometer, an auxiliary radiation source, and a computer. Four radiation spectra are recorded: (1) the unobstructed spectrum characterizing an auxiliary radiation source; (2) the unobstructed spectrum characterizing the interfering radiation; (3) the radiation spectrum consisting of surface emission plus the interfering radiation; and (4) a spectrum consisting of the radiations of (3) plus the reflected radiation due to the incidence of the auxiliary radiation source on this surface. With these spectra, application of two variable, nonlinear, least squares, curve fitting computer software determines the surface temperature and the spectral emissivity. Use of the method to measure the surface temperature of silicon carbide under a simulated interference condition is shown at a low temperature just above ambient. The instrumentation necessary to extend the method to elevated temperatures is discussed.
Author

N92-19177# Naval Research Lab., Washington, DC.
ON THE POSSIBILITY OF HIGH POWER GYROTRONS FOR SUPER RANGE RESOLUTION RADAR AND ATMOSPHERIC SENSING
Wallace M. Manheimer 20 Dec. 1991 44 p
(AD-A244041; NRL-MR-6830) Avail: NTIS HC/MF A03 CSCL 09/1

High power gyrotrons have been developed recently; this makes a number of high power millimeter wave oscillators available. Currently their main application is the heating of fusion plasmas. This examines other potential applications for these RF sources. If used in multipulse radar mode, the pulses may be somewhat different from each other and this must be considered. A variant of coherent on receive can be used. With this, the entire pulse, not only the phase, is renormalized to a reference pulse. The data are analyzed off line. Possible applications of the Quasi-optical gyrotron in a radar mode include exploiting its wide tuning range to achieve super range resolution and also remotely sensing the distribution of the size of ice crystals in cirrus clouds. Possible applications of a fixed frequency (94 GHz) gyrotron in radar mode include studying the structure of clouds. In a forward scatter mode, these high power sources could provide the capability to remotely sense the structure of clear air turbulence. The tunability of the quasi-optical gyrotron could also be exploited to rapidly perform measurements of relative humidity on the ground and in clouds, and to perform two-way earth to space measurements of upper atmosphere trace element concentrations. GRA

N92-19263*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TEMPERATURE-DEPENDENT REFLECTIVITY OF SILICON CARBIDE
Daniel Ng Feb. 1992 11 p
(NASA-TM-105287; E-6618; NAS 1.15:105287) Avail: NTIS HC/MF A03 CSCL 14B

The spectral reflectivity of a commercial silicon carbide (SiC) ceramic surface was measured at wavelengths from 2.5 to 14.5 microns and at temperatures ranging from 358 to 520 K using a NASA-developed multiwavelength pyrometer. The SiC surface reflectivity was low at the short wavelengths, decreasing to almost zero at 10 microns, then increasing rapidly to a maximum at approximately 12.5 microns, and decreasing gradually thereafter. The reflectivity maximum increased in magnitude with increasing surface temperature. The wavelength and temperature dependence can be explained in terms of the classical dispersion theory of crystals and the Lorentz electron theory. Electronic transitions between the donor state and the conduction band states were responsible for the dispersion. The concentration of the donor state in SiC was determined to be approximately 4 x 10 exp 18 and its ionization energy was determined to be approximately 71 meV.
Author

N92-19417# Ames Lab., IA.
THE DESIGN, CONSTRUCTION AND APPLICATIONS OF A NOVEL DOUBLE-AXI HELIUM ATOM SPECTROMETER Ph.D. Thesis
R. Folkerts 20 Dec. 1991 152 p
(Contract W-7405-eng-82)
(DE92-005091; IS-T-1579) Avail: NTIS HC/MF A08

A novel helium atoms spectrometer has been developed for the study of elastic and inelastic collisions with surfaces. The spectrometer is a double-axis design, providing the experimentalist with the capability of using an analyzer crystal to provide energy resolution for either elastic or inelastic experiments. The spectrometer is novel in that scattering angle at both axes may be adjusted during the experiment, allowing great flexibility in the design and execution of experiments of solid surfaces. The mechanisms and operating characteristics of the spectrometer are described. The initial tests of the spectrometer, using the well characterized LiF(001) surface, are also presented. These tests demonstrate that the spectrometer may function as a high precision double-axis diffractometer. During these initial tests, spurious scattering events and an insufficient signal to background ratio prevented the observation of single phonon scattering. Subsequent modifications to improve the signal to background are described.
DOE

N92-19460# Ballistic Research Labs., Aberdeen Proving Ground, MD.
SHOCK TESTING OF A KULITE PRESSURE GAGE Final Report, Jun. - Sep. 1991
James M. Garner and Timothy J. McAveney Dec. 1991 15 p
(AD-A243962; BRL-MR-3952) Avail: NTIS HC/MF A03 CSCL 14/2

A program designed to measure in-flight base pressure is presently underway at the Launch and Flight Division of the Ballistic Research Laboratory. The pressure gages used in the projectile must withstand projectile accelerations (from 10,000-20,000 g's) if they are to be effective. Shock tests were performed on Kulite pressure gages model No. XT-39-190-25A to determine its response to this type of acceleration level. This report details the workings of the Impac Shock Machine as well as the effect of acceleration on gage performance. GRA

N92-19462# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PERFORMANCE ANALYSIS OF THE SPECKLE HOLOGRAPHY IMAGE RECONSTRUCTION TECHNIQUE M.S. Thesis
Rudolf N. VonNiederhausern Dec. 1991 82 p
(AD-A243966; AFIT/GEO/ENG/91D-05) Avail: NTIS HC/MF A05 CSCL 14/1

In speckle holography, short exposure frames along with wave front measurements allow post processing image reconstruction. With speckle holography, the amplitude of high spatial frequencies is boosted to allow resolution out to the diffraction limit of the

telescope. To provide system parameters for the wave front sensor design, a software analysis program has been developed that provides the system transfer function as a function of the number and size of sensor subapertures and sensor noise. Trends in the ratio of the atmospheric coherence diameter to wave front subaperture size and the effect on the system transfer function have been obtained. Data obtained with the system transfer function algorithm depicts the criticality of the ratio of r (sub o) (atmospheric coherence diameter) to the wave front sensor subaperture size. For a ratio of r (sub o) to subaperture size of 2 to 1, the amplitude of high spatial frequencies are boosted to nearly 70 percent of the amplitude of lower spatial frequencies. GRA

N92-19497 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
ANGULAR SELECTIVITY OF VOLUME HOLOGRAMS WITH SUPPORTING SPECKLE-WAVE [UGLOVAIA SELEKTIVNOST OB EMNYK GOLOGRAMMS OPORNOI SPEKL-VOLNOI]
A. M. Darskii and V. B. Markov 1989 38 p In RUSSIAN
Copyright Avail: Issuing Activity

Theoretical and experimental research was conducted on the diffraction of light on a hologram with a supporting speckle-wave. Research indicates that the new mechanism of angular selectivity is present in such a hologram. The mechanism is associated with the spatial mismatch of the recorded and printed-out data from the speckle-structure. In particular, the hologram, as opposed to the elementary holographic lattice, possesses a significant angular selectivity due to its rotation about an arbitrary axis located in the entry plane of the hologram. During rotation about the axis and parallel to the layers of the lattice, the general angular selectivity of the hologram is defined by the joint movement of angular selectivity of the cross lattice and angular spacial mismatch of the speckle-structure. Transl. by L.K.H.

N92-19596*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LASER-SPECTROSCOPIC MEASUREMENT TECHNIQUES FOR HYPERSONIC, TURBULENT WIND TUNNEL FLOWS
Robert L. McKenzie and Douglas G. Fletcher Mar. 1992 13 p
(NASA-TM-103928; A-92076; NAS 1.15:103928) Avail: NTIS HC/MF A03 CSCL 14B

A review is given of the nature, present status, and capabilities of two laser spectroscopic methods for the simultaneous measurement of temperature, density, and their fluctuations owing to turbulence in high speed wind tunnel flows. One method is based on the two frequency excitation of nitric oxide seeded into a nitrogen flow, using tunable dye lasers. The second, more recent method relies on the excitation of oxygen in air flows using a tunable, ArF excimer laser. Signal are obtained from both the laser induced fluorescence and from Raman scattering of the same laser pulse. Measurements are demonstrated in the turbulent boundary layer of a Mach-2 channel flow. Author

N92-19775*# Ametek, Inc., Wilmington, MA.
HIGH ACCURACY FUEL FLOWMETER. PHASE 2C AND 3: THE MASS FLOWRATE CALIBRATION OF HIGH ACCURACY FUEL FLOWMETERS Final Report
D. William Craft Feb. 1992 87 p
(Contract NAS3-24357)
(NASA-CR-187108; NAS 1.26:187108) Avail: NTIS HC/MF A05 CSCL 14B

A facility for the precise calibration of mass fuel flowmeters and turbine flowmeters located at AMETEK Aerospace Products Inc., Wilmington, Massachusetts is described. This facility is referred to as the Test and Calibration System (TACS). It is believed to be the most accurate test facility available for the calibration of jet engine fuel density measurement. The product of the volumetric flow rate measurement and the density measurement, results in a true mass flow rate determination. A dual-turbine flowmeter was designed during this program. The dual-turbine flowmeter was calibrated on the TACS to show the characteristics of this type of flowmeter. An angular momentum flowmeter was also calibrated on the TACS to demonstrate the accuracy of a true mass flowmeter having a 'state-of-the-art' design accuracy. Author

N92-19792# Sandia National Labs., Albuquerque, NM.
THE USE OF MODAL ANALYSIS IN THE DEVELOPMENT OF ADVANCED LITHOGRAPHY MACHINES
D. P. Roach 1991 19 p Presented at the 10th International Modal Analysis Conference (IMAC), San Diego, CA, 3-6 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004742; SAND-91-1367C; CONF-920234-2) Avail: NTIS HC/MF A03

The use of modal analysis as a diagnostic tool is rapidly increasing. This paper describes a unique application of this technology in the analysis of an advanced lithography machine. This machine, a 'step-and-repeat' system, uses a photographic process to print electronic circuit patterns on wafers with resolutions on the order of nanometers. Consequently, it is imperative for the structural response to be controlled during the machine's normal operations. Modal, vibration, and timing control experiments were conducted in order to assess the various design features which provide optimum machine performance. It was determined that the vibration sources and the stiffness of the machine components are tailored to complement each other such that all potential problem areas are avoided. In addition, special design features are employed to allow the machine to quickly optimize conditions (such as wafer residual motion and positioning error) prior to wafer exposure. The ultimate goal of this investigation is to provide guidelines to improve the accuracy and reliability of lithography equipment and to aid in the development of more advanced machines. DOE

N92-19816# Geological Survey, Reston, VA. Resources Div.
TEMPERATURE SENSITIVITY OF MERCURY-MANOMETER BUBBLE GAGES
W. H. Kirby 1991 26 p
(PB92-114933; USGS/WRI-91-4038) Avail: NTIS HC/MF A03 CSCL 14B

Elementary hydrostatic analysis shows that water-level measurements made with mercury manometers are subject to errors of approximately 0.02 percent per degree Celsius due to uncorrected variations in the temperature of the mercury. Normal diurnal variations in air temperature if uncorrected are sufficient to cause errors of +/- 0.15 percent or more. Errors of this magnitude would exceed the U.S. Geological Survey's pre-1989 tolerance of +/- 0.05 percent of full scale for stage-measurement instrumentation if the water levels measured were above one-third of full scale. Under the current (1991) more stringent tolerance of 0.02 percent of full scale, errors of this magnitude would exceed the tolerance at almost any water level. An informal survey conducted in 1986 indicated that most Geological Survey manometers do in fact operate at less than one-third of full scale for all but a few days per year, and that temperature sensitivity is relatively unimportant in comparison to other sources of error in measurements of high-water levels at stream-gauging stations. GRA

N92-19873# SQM Technology, Inc., La Jolla, CA.
DEVELOPMENT OF AN ELECTROMAGNETIC MICROSCOPE FOR EDDY CURRENT EVALUATION OF MATERIALS Annual Technical Report
Walter N. Podney Aug. 1991 24 p
(Contract F49620-90-C-0058)
(AD-A242007; SQMT-91-101R; AFOSR-91-0785TR) Avail: NTIS HC/MF A03 CSCL 09/5

Superconducting quantum interference devices (SQUIDs) offer new technology for locating material flaws electromagnetically. These devices offer increased sensitivity and enhanced image resolution. The sensitivity of SQUIDs to magnetic flux allows use of microscopic pickup loops in a gradiometer configuration to give high resolution. In an effort to develop SQUID technology for use in the evaluation of airframes, an electromagnetic microscope is

being developed in accordance with Air Force requirements. The microscope uses an array of microscopic pickup loops for imaging micro-flaws in aluminum. The prototype is comprised of a triangular array of microscopic gradiometers that are coupled to SQUID sensors through a flexible, cryogenic umbilical, which enables convenient scanning. At this time, the development has achieved three main accomplishments: (1) a planar, azimuthal gradiometer configuration that enables suppression of source interference; (2) the instrument noise at drive currents of approximately 1 A and frequencies below a few kilohertz is on the order of SQUID noise; and (3) a cryogenic umbilical that can provide adequate cooling over a four to six foot length. GRA

N92-19920*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A REAL-TIME RECURSIVE FILTER FOR THE ATTITUDE DETERMINATION OF THE SPACELAB INSTRUMENT POINTING SUBSYSTEM
M. E. West Feb. 1992 206 p
(NASA-TM-103573; NAS 1.15:103573) Avail: NTIS HC/MF A10 CSCL 14B

A real-time estimation filter which reduces sensitivity to system variations and reduces the amount of preflight computation is developed for the instrument pointing subsystem (IPS). The IPS is a three-axis stabilized platform developed to point various astronomical observation instruments aboard the shuttle. Currently, the IPS utilizes a linearized Kalman filter (LKF), with premission defined gains, to compensate for system drifts and accumulated attitude errors. Since the a priori gains are generated for an expected system, variations result in a suboptimal estimation process. This report compares the performance of three real-time estimation filters with the current LKF implementation. An extended Kalman filter and a second-order Kalman filter are developed to account for the system nonlinearities, while a linear Kalman filter implementation assumes that the nonlinearities are negligible. The performance of each of the four estimation filters are compared with respect to accuracy, stability, settling time, robustness, and computational requirements. It is shown, that for the current IPS pointing requirements, the linear Kalman filter provides improved robustness over the LKF with less computational requirements than the two real-time nonlinear estimation filters. Author

N92-19986# Brookhaven National Lab., Upton, NY.
VACUUM BEHAVIOR OF THE X RAY LITHOGRAPHY SOURCE
H. J. Halama and J. B. Murphy 1991 12 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC02-76CH-00016)
(DE92-007172; BNL-46996; CONF-911132-19) Avail: NTIS HC/MF A03

Photon stimulated desorption (PSD) is the major source of the gas load in electron storage rings and therefore strongly influences both beam lifetime and beam quality. The 200 MeV compact ring at the NSLS is an ideal tool to study PSD since its energy can be varied from 60 to 200 MeV and the photoelectrons produced by synchrotron radiation can be measured in clearing electrodes installed to collect trapped ions. Using these electrodes we show: (1) photoelectrons are produced only by photons having energy above 10eV, and (2) desorption is proportional to the number of photoelectrons. Using calibrated gauges we conclude that (1) time-integrated beam current of 10-20 Ampere-hours is needed for initial vacuum chamber clean-up, (2) venting the chamber to dry nitrogen has a negligible effect on subsequent desorption, and (3) venting to air requires about 10 Ampere-hours of beam conditioning. DOE

N92-20012# California Univ., Berkeley. Lawrence Berkeley Lab.
A DIRECT COMPARISON OF Ge AND Si(Li) DETECTORS IN THE 2-20 keV RANGE
C. S. Rossington, R. D. Giauque, and J. M. Jaklevic Oct. 1991 7 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004170; LBL-30614; CONF-911106-43) Avail: NTIS HC/MF A02

The spectral response of high purity Ge (HPGe) and lithium-drifted Si (Si(Li)) surface barrier detectors of similar geometry was measured over a range of x-ray energies under identical experimental conditions. Detector characteristics such as spectral background, escape peak intensity, entrance window absorption, and energy resolution are presented and compared. Although these characteristics were discussed in the literature previously, this paper represents an attempt to consolidate the information by making comparisons under equivalent experimental conditions for the two types of detectors. A primary goal of the study is a comparison of the two types of detectors for use in x-ray fluorescence applications. DOE

N92-19322*# California State Univ., Sacramento. Dept. of Mechanical Engineering.
LOW FLOW VORTEX SHEDDING FLOW METER FOR HYPERGOLICS/ALL MEDIA
Ngo Dinh Thinh *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 507-534 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-19210 Department of the Navy, Washington, DC.
LASER DETECTION AND DISCRIMINATION SYSTEM Patent
Kishalaya Chakrabarti, inventor (to Navy) and Veerendra K. Mathur, inventor (to Navy) 3 Sep. 1991 7 p Filed 16 Aug. 1989
(AD-D015115; US-Patent-5,045,707; US-Patent-Appl-SN-394457; US-Patent-Class-250-484.1) Avail: US Patent and Trademark Office CSCL 17/5

Magnesium oxide sensing materials is pretreated and charged by UV radiation to identify impingement thereon of radiation from a near infrared laser source by detection of blue emissions which persist for an unusually long periods of time, avoiding frequent respotting and recharging. When heated to thermoluminescence peaks above room temperature by irradiation from a far infrared laser source, the magnesium oxide exhibits green luminescence enabling wavelength discrimination between detection of near and far infrared laser sources. Such pretreated magnesium oxide also produces green emissions when irradiated by UV laser sources, to distinguish between detection of the UV laser sources and the far infrared laser sources by discrimination between different fading behaviors of the green emissions. GRA

N92-19297# Ecole Nationale Superieure des Telecommunications, Paris (France). Lab. d'Optoelectronique.
NOISE AND MODULATION OF DISTRIBUTED FEEDBACK SEMICONDUCTOR AND COMPOSITE CAVITY LASERS Ph.D. Thesis [BRUIT ET MODULATION DES LASERS A SEMICONDUCTEURS A CONTRE-REACTION DISTRIBUEE ET A CAVITE COMPOSITE]
Guang-Hua Duan 1991 245 p In ENGLISH and FRENCH
(TELECOM-Paris-91-E-003; ISSN-0751-1353; ETN-92-91031)
Avail: NTIS HC/MF A11

A theoretical and experimental study of noise and modulation of high performance lasers is presented. The Green's function method is generalized for complex structure lasers. In particular, two important parameters were studied: the rate of the spontaneous emission coupled to the lasing mode and the effective phase amplitude coupling factor. The enhancement of the spontaneous emission rate is calculated for different laser structures. The sensitivity of these lasers to external reflections is defined. For multielectrode lasers, it is shown that the spontaneous emission rate and the effective phase amplitude coupling factor depend

simultaneously on the current injection conditions. A chirp reduction was experimentally obtained and a substantial change of the oscillation relaxation was observed for a distributed feedback laser submitted to an external optical feedback. These results are consistent with the generalized rate equations model. The locking of a distributed Bragg reflector laser to a frequency modulation sideband of another such laser was demonstrated. An extended cavity laser with 40 nm tunability and 100 kHz linewidth was realized. A heterodyne detection system was demonstrated using this tunable laser and a distributed feedback laser. The experimental results of the modulation and noise properties for a two electrode distributed Bragg reflector laser are also presented. It is shown, that the drive current noise of the Bragg section introduces an important supplementary linewidth. The influence of the nonlinear effects on the spectal linewidth of the monosection distributed feedback laser is investigated. It is shown that the material intraband gain saturation leads to an increase of the phase amplitude coupling factor. The spatial hole burning has no significant consequence in the dynamic and noise properties of semiconductor lasers. ESA

N92-19357# Lawrence Livermore National Lab., CA.
SOFT X RAY LASER SOURCE DEVELOPMENT AND APPLICATIONS: WORLDWIDE PROGRESS
C. J. Keane Oct. 1991 50 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE92-005248; UCRL-JC-107982; CONF-9107115-62) Avail: NTIS HC/MF A03

The field of soft x-ray laser research is at a point between the first demonstrations of x-ray amplification and the onset and widespread application of modest-sized x-ray lasers. The past several years have seen great strides in x-ray amplifier performance as well as the demonstration of proof-of-principle x-ray laser applications. In the near term, the challenge for the x-ray laser community will be to develop compact x-ray lasers and to carry out an applications experiment of crucial importance to an identifiable community of interested users. Achieving these goals will require furthering our understanding of basic amplifier physics and increasing our technological capabilities with x-ray lasers. In this paper, we summarize the results obtained to date in these areas with emphasis on the most recent developments. DOE

N92-19455# Textron Defense Systems, Everett, MA.
LASER FREQUENCY MULTIPLICATION
Nov. 1991 1 p
(Contract N00014-91-C-2279)
(AD-A243864) Avail: NTIS HC/MF A01 CSCL 09/3

A high quality mode locked pulse train was obtained at 9.55 microns, the CO2 wavelength chosen for frequency doubling into the atmospheric window at 4.8 microns. The pulse train consists of a 3 micro sec burst of 1.5 nsec pulses separated by 40 nsec, in a TEM (sub 00) mode and with a total energy of 100 mJ. The pulse intensity without focussing is about 3 MW/sq.cm., already quite close to the target intensity of 10 MW/sq.cm. for frequency doubling in a AgGaSe2 crystal. The mode-locked train is obtained by intracavity modulation at 12.5 MHz using a germanium crystal driven with a power of about 30 Watts. Line selection is achieved firstly by the use of a 0.92 mm thick CaF2 plate at the Brewster angle within the cavity, which completely suppresses 10.6 micron band radiation. Secondly, a particular rotational line, the P20 at 9.55 micron, is selected by the injection of a continuous beam is mode-matched to the pulsed laser cavity using a long focal length lens, and for best line-locking it is necessary to fine tune the length of the pulsed laser resonator. Injection causes substantial depression of the gain switched spike. GRA

N92-19502 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
INVESTIGATION OF FREQUENCY-MODULATED RESONANCES IN He-Ne/CH4 LASERS [ISSLEDOVANIE CHASTOTNO-MODULIATSIONNYKH REZONANSOV V HE-NE/CH4 LAZERAKH]
V. M. Grinenko, M. V. Danileinko, V. N. Nechiporenko, A. M. Fal, and L. P. Iatsenko 1989 37 p In RUSSIAN
Copyright Avail: Issuing Activity

The characteristics of frequency modulation resonance in the He-Ne/CH4 emissions of lasers with a Fabry-Perot resonator are experimentally and theoretically investigated. The possibility of accepting these resonators in the capacity of frequency references, and also in the spectroscopy of ultra-high distortion, is considered. Transl. by L.K.H.

N92-19516# Naval Research Lab., Washington, DC.
MODELING MODAL TRANSIENT BEHAVIOR OF GaAs LASER DIODES WITH TEMPERATURE DEPENDENT RATE EQUATIONS AND COMPARISON TO EXPERIMENTAL DATA
Memorandum Report
Wendy L. Lippincott and William C. Collins 26 Dec. 1991 99 p (AD-A244097; NRL-MR-6901; SPAWAR-004-5/014-90) Avail: NTIS HC/MF A05 CSCL 09/3

Theoretical predictions based on temperature dependent rate equations are made of the pulse response of the individual axial modes of high power laser diodes. The temperature transients in the active area of the lasers are simulated with a finite element code and entered into the rate equations which describe the time evolution of both the carrier population and the photon number inside the laser cavity. Experimentally, the laser diodes are triggered by a fast electrical pulse and the modes of gain-guided AlGaAs laser diodes are dispersed with a echelle grating and individually imaged onto a scanning avalanche photodiode (ADP). The results of this study showed that modal instabilities during pulsed operation of the laser diodes can be separated into two types of transients: mode buildup transients and thermally-induced transients. Mode buildup transients, due to feedback from the cavity gradually causing power to concentrate in a few modes, were found to last up to 60 ns depending on laser length, whereas thermally-induced transients were found to last several hundred nanoseconds and are dependent on the overall efficiency of the laser. Our experimental results show that broad-stripe lasers, which minimize current spreading, have much smaller temperature transients as compared to narrow single-stripe lasers. GRA

N92-19531# European Space Agency, Paris (France).
LASER TECHNOLOGY FOR SPACE TASKS
Uwe Brauch, Wolfgang Schall, Gerhard Spindler, Wolfram Wittwer, and Eberhard Zeyfang (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) Aug. 1991 42 p Transl. into ENGLISH of Lasertechnologie fuer Raumfahrtaufgaben (Stuttgart, Fed. Republic of Germany, DLR), 1990 114 p Original language document was announced as N91-12080
(ESA-TT-1246; DLR-FB-90-10; ETN-92-90746) Avail: NTIS HC/MF A03; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 41.50 DM

The use of lasers for a large variety of tasks in space is discussed. Its contribution to energy supply, to transportation and to debris elimination is considered. It is decided that the use of lasers could grow greatly in significance, particularly with an increasing utilization of space up to its industrialization. It is found that laser technology is a universally applicable technology with a high potential for the future in this area. Corresponding research and development work should therefore be started today. ESA

N92-19574# Los Alamos National Lab., NM.
ELECTRON-BEAM AND HIGH SPEED OPTICAL DIAGNOSTICS FOR THE AVERAGE POWER LASER EXPERIMENT (APLE) PROGRAM
A. H. Lumpkin, B. D. McVey, R. B. Greegor, and D. H. Dowell 1991 20 p Presented at the 13th International Free-Electron

Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract W-7405-eng-36)
(DE92-005012; LA-UR-91-3899; CONF-9108118-41) Avail: NTIS HC/MF A03

The Average Power Laser Experiment (APLE) program is a collaboration of Boeing and Los Alamos to build a free-electron laser (FEL) operating at a wavelength of 10 microns and an average power of 100 kW. This program includes demonstration experiments at Boeing on the injector and at Los Alamos on a single accelerator master oscillator power amplifier (SAMOPA). In response to the simulations of the expected electron beam properties, diagnostic plans have been developed for the low-duty and the 25 percent-duty operations of APLE. Preliminary evaluations of diagnostics based on information conversion to visible or near infrared light (optical transition radiation, Cerenkov radiation, synchrotron radiation, and spontaneous emission radiation) or electrical signals (striplines, toroids, flying wires, etc.) are addressed. DOE

N92-19579# Los Alamos National Lab., NM.
LASER-DRIVEN FLYER PLATE Patent Application
D. L. Paisley, inventor (to DOE) 2 Apr. 1990 11 p
(Contract W-7405-eng-36)
(DE92-003832; US-Patent-Appl-SN-502956; Patents-US-A7502956) Avail: NTIS HC/MF A03

This invention is comprised of apparatus for producing high velocity flyer plates involving placing a layer of dielectric material between a first metal foil and a second metal foil. With laser irradiation through an optical substrate, the first metal foil forms a plasma in the area of the irradiation, between the substrate and the solid portion of the first metal foil. When the pressure between the substrate and the foil reaches the stress limit of the dielectric, the dielectric will break away and launch the flyer plate out of the second metal foil. The mass of the flyer plate is controlled, since no portion of the flyer plate is transformed into a plasma. DOE

N92-19591# Brookhaven National Lab., Upton, NY.
EFFECTS OF VARIATION OF THE LASER PULSE WIDTH ON THE LASER INDUCED PHOTOELECTRONS
Z. Parsa 1991 10 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract DE-AC02-76CH-00016)
(DE92-004984; BNL-46795; CONF-9108118-40) Avail: NTIS HC/MF A02

The effects of the variation of the Laser pulse width on the laser induced photoelectrons, from the BNL gun is presented, including the variation in the emittance of the beam, which is crucial to the operation of a Free Electron Laser (FEL). The radio frequency (RF) electron gun with a photocathode in the end wall of an RF cavity is excited by a laser pulse that is synchronized with the RF, is powered by a conventional type SLAC klystron, and is designed to produce a low emittance beam of 4.65 MeV at the gun exit with the field gradient of 100 MV/m on the cathode. DOE

N92-19594# Brookhaven National Lab., Upton, NY.
PERFORMANCE OF THE BROOKHAVEN PHOTOCATHODE RF GUN
K. Batchelor, I. Ben-Zvi, R. C. Fernow, J. Fischer, A. S. Fisher, J. Gallardo, G. Ingold, H. G. Kirk, K. P. Leung, and R. Malone et al 1991 9 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005008; BNL-46679; CONF-9108118-38) Avail: NTIS HC/MF A02

The Brookhaven Accelerator Test Facility (ATF) uses a photocathode RF gun to provide a high brightness electron beam intended for FEL and laser acceleration experiments. The RF gun consists of 1(1/2) cells driven at 2856 MHz in pi-mode with a maximum cathode field of 100 MV/m. To achieve long lifetimes, the photocathode development concentrates on robust metals such as copper, yttrium and samarium. We illuminate these cathodes with a 10 ps, frequency quadrupled Nd:YAG laser. We describe the initial operation of the gun, including measurements of transverse and longitudinal emittance, quantum efficiencies, and peak current. The results are compared to models. DOE

N92-19706# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
OPTICAL PHASE CONJUGATION VIA STIMULATED BRILLOUIN SCATTERING IN A BRILLOUIN RING LASER M.S. Thesis
Jeffrey J. Druessel Dec. 1991 60 p
(AD-A243939; AFIT/GEP/ENP/91D-5) Avail: NTIS HC/MF A04 CSCL 20/6

Stimulated Brillouin scattering (SBS) was demonstrated in multimode optical fiber using a Brillouin ring laser configuration. The frequency shift of the SBS generated output beam was measured at 33.1 GHz. Pump laser power thresholds for SBS onset were determined for several ring cavity configurations and compared to theoretical values. Optical phase conjugating properties of SBS in multimode optical fiber were investigated. The phase conjugation of an aberrated pump beam was not evident in the Brillouin ring laser output. GRA

N92-19857# Lawrence Livermore National Lab., CA.
COHERENT SOFT X RAY GENERATION WITH 10 TW LASER
J. Crane, M. Perry, R. Falcone, K. Budil, R. Gonzales, and K. Haney Nov. 1991 33 p
(Contract W-7405-eng-48)
(DE92-006429; UCRL-ID-108778) Avail: NTIS HC/MF A03

We have generated the 35th harmonic of 527 nm in helium coherent radiation at 150 A. In neon, we observe strong fluorescence down to 51 A from recombination pumped excited states in Ne8 (Li-like neon). In this memo, we describe these results and others from our first experiments in generating short-pulse, short-wavelength, coherent radiation in the 10 TW Laser Facility. DOE

N92-19864# International Centre for Theoretical Physics, Trieste (Italy).
LASER PARAMETERS OF QUANTUM-WELL HETEROSTRUCTURES
V. K. Kononenko and I. S. Zakharova (Akademiya Nauk BSSR, Minsk.) May 1991 26 p
(DE92-603749; IC-91/63) Avail: NTIS HC/MF A03

For laser quantum-well heterostructures, an analysis of the stimulated emission frequencies depending on the sizes and composition of the active region and wide-band gap emitters is carried out. In the model without the k-vector-selection rule, the internal parameters are determined and optimal conditions for laser action are indicated. DOE

N92-19880# Brookhaven National Lab., Upton, NY.
ANALYSIS OF A HIGH BRIGHTNESS PHOTO ELECTRON BEAM WITH SELF FIELD AND WAKE FIELD EFFECTS
Z. Parsa 1991 11 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract DE-AC02-76CH-00016)
(DE92-004983; BNL-46794; CONF-9108118-39) Avail: NTIS HC/MF A03

High brightness sources are the basic ingredients in the new accelerator developments such as Free-Electron Laser experiments. The effects of the interactions between the highly charged particles and the fields in the accelerating structure, e.g., R.F., space charge and wake fields can be detrimental to the beam and the experiments. We present and discuss the formulation used, some simulation and results for the Brookhaven National Laboratory high brightness beam that illustrates effects of the accelerating field, space charge forces (e.g., due to self field of the bunch), and the wake field (e.g., arising from the interaction of the cavity surface and the self field of the bunch). DOE

N92-19881# Lawrence Livermore National Lab., CA.
LASER DAMAGE RESULTS ON PLANAR HIGH TEMPERATURE CHEMICAL VAPOR DEPOSITION COATINGS
R. M. Brusasco Dec. 1991 10 p Presented at the 23rd Annual Boulder Damage Symposium on Optical Materials for High-Power Lasers, Boulder, CO, 23-25 Oct. 1991
(Contract W-7405-eng-48)
(DE92-005247; UCRL-JC-108267; CONF-911064-1) Avail: NTIS HC/MF A02

Experiments in three different RF-based (13.56 MHz) plasma reactors located in the U.S. and two different microwave-based (2.45 GHz) deposition systems located in Europe were conducted and the laser damage threshold results at 1064 nm as well as some uniformity and reflectivity data are given. The RF-based plasma reactors fail to produce multilayers with visible optical interference effects. Microwave-based plasma systems were successful in preparing rugate-type dielectric reflectors with index modulation (Delta n) up to 0.034 and reflectivities up to 95 percent. The laser damage threshold was strongly dependent on reactor geometry. A vertical tube furnace arrangement gave the highest damage thresholds (greater than 40 J cm(exp -2)) when cylindrical or rectangular cross-section tubes were used. Planar substrate geometries were a factor of 3 to 10 lower. RF-based coating systems were also low (5 to 12 J cm(exp -2)) regardless of the deposition chemistry used or the reactor geometry tried. DOE

N92-19989# Lawrence Livermore National Lab., CA.
KINETICS EXPERIMENTS ON NEON-LIKE X RAY LASERS
D. J. Fields, R. S. Walling, A. R. Fry, G. M. Shimkaveg, T. W. Phillips, A. L. Osterheld, B. J. MacGowan, L. B. DaSilva, R. E. Stewart, and W. H. Goldstein et al 18 Dec. 1990 6 p Presented at the Second International Colloquium on X ray Lasers, York (United Kingdom), 17-21 Sep. 1990
(Contract W-7405-eng-48)
(DE92-007352; UCRL-JC-104646; CONF-9009266-14) Avail: NTIS HC/MF A02

Recent results from experiments with neon-like x-ray lasers are discussed. Lasing in an Ag amplifier is demonstrated. The strong J = 2-1 transitions are shown to have large gains. A J = 0-1 transition at 81.57 Angstroms is the shortest lasing transition yet observed in neon-like ions. A quasi-CW laser is demonstrated in experiments with germanium amplifiers. A substantial difference is shown to exist between the spectroscopy of lasers produced in exploding foils and slab targets. Experiments with over-ionized germanium lasers are also discussed. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-19093# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ROBOTIC TACTILE SENSORS FABRICATED FROM A MONOLITHIC SILICON INTEGRATED CIRCUIT AND A PIEZOELECTRIC POLYVINYLIDENE FLUORIDE THIN FILM M.S. Thesis
Craig S. Dyson Dec. 1991 392 p
(AD-A243886; AFIT/GE/ENG/91D-16) Avail: NTIS HC/MF A17 CSCL 23/3

The purpose of this research effort was to design, fabricate, and test a tactile sensor system consisting of an external high impedance switch circuit, an external multiplexing circuit, and a tactile sensor IC. In order to accomplish this objective, a hardware design and selection process was implemented along with a logical test methodology. An external multiplexer circuit samples all of the array elements in 50 ms. The current prototype sensor has linearity spanning loads of 0.8 g to 135 g, a load resolution of 20 g, and a maximum bandwidth of 25 Hz. Using an elementary shape recognition algorithm the sensor can recognize the shape of a contact load with a spatial resolution on the order of 700 micron. A comparison of three different adhesives used to bond the piezoelectric PVDF film to the surface of the electrode array was made and a urethane adhesive was selected for its superior electrical and physical properties. Author (GRA)

N92-19198# Missouri Univ., Rolla.
PROCEEDINGS OF THE 22ND MIDWESTERN MECHANICS CONFERENCE. VOLUME 16: DEVELOPMENTS IN MECHANICS Final Report
R. C. Batra and B. F. Armaly Oct. 1991 645 p Conference held in Rolla, MO, 6-9 Oct. 1991
(Contract DAAL03-91-G-0197)
(AD-A244162; ARO-28904.1-MA-CG-Vol-16) Avail: NTIS HC/MF A99 CSCL 13/13

An overview will be provided of the research thrust in Mechanics of Composites within the Mechanics Division at the Office of Naval Research. Recent accomplishments will be summarized and future research directions will be discussed. Naval structures operate in a variety of hostile environments and are subjected to complex loading conditions. Composite materials have been used extensively in high performance naval aircraft and missile structures. Composites have the potential of providing many advantages, including greater depth capabilities and enhanced stealth characteristics for submersibles. There is increased activity in thick composites research, especially in the area of the response of thick composites to compressive stress fields. Research issues being addressed include three-dimensional constitutive equations and lamination theories, micromechanics, damage evolution, failure modes and mode coupling, failure theories, environmental effects, dynamic response and quantitative nondestructive evaluation. Recent accomplishments include: three dimensional lamination theories based on micromechanics considerations; delamination crack propagations compression failure in unidirectional composites; moisture induced damage and effects of stress; impact damage models and concepts for controlling impact damage; coupling between local material failure and structural failure; and scanning acoustic microscopy for assessment of near surface microstructure. GRA

N92-19208 Department of the Navy, Washington, DC.
T-SLOT SHEAVE Patent
Eldon N. Jorgensen, inventor (to Navy) 15 Oct. 1991 7 p Filed 2 Apr. 1990
(AD-D015112; US-Patent-5,056,760; US-Patent-Appl-SN-507264; US-Patent-Class-254-406) Avail: US Patent and Trademark Office CSCL 20/11

A sheave that has the advantage of being able to be quickly coupled to a cable, and quickly decoupled from the cable is discussed. A further advantage is that the shaft of the pulley on which the cable rides is journaled at each end in side members that interlock when the sheave is in its closed position to support the shaft both from above the pulley, and from below. Other advantages include that the interlock is an arcuate T-shaped extension in the rotatable side member and a corresponding arcuate T-slot groove with which it engages in the stationary side member. The rotatable side member is affixed to the shaft of the pulley and is operable to rotate about the shaft from its closed and interlocked position to its open and disengaged position whereat the pulley is exposed such that the cable, cord or the like may be coupled or decoupled to the pulley. In the open position the side members only are connected by way of the pulley's shaft, whereas in the closed and load bearing position the side members additionally are supported to one another by the T-slot interlock that is both above and below the pulley. A slip ring lock is included to retain the side members in their interlocked position. Author (GRA)

N92-19232# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PRINCIPAL BASE PARAMETER ANALYSIS: IMPLEMENTATION AND ANALYSIS IN AN ADAPTIVE MODEL-BASED ROBOTIC CONTROLLER M.S. Thesis
Gregory L. Showman Dec. 1991 134 p

(AD-A243833; AFIT/GE/ENG/91D-48) Avail: NTIS HC/MF A07 CSCL 09/1

Principal Base Parameter Analysis (PBPA) is a general and systematic procedure for determining the dynamic parameters that directly contribute to the joint torques of a manipulator, ranked in order of sensitivity. The feasibility of employing PBPA as an aid in the design and tuning of adaptive model-based controllers for industrial manipulators is rigorously investigated. This is accomplished by employing PBPA to determine the minimal size of the adaptive parameter vector and more importantly, to develop a less heuristic procedure for controller tuning. A simple, step-by-step procedure is developed wherein the manipulator torque equations are used in conjunction with PBPA to develop a functional adaptive model-based control (AMBC) algorithm, then tune the algorithm for optimal performance. Experimental analysis contrasts this adaptive model-based controller, designed and tuned using PBPA, to the completely heuristic procedure employed in previous Air Force Institute of Technology research. The incorporation of PBPA into the AMBC design methodology reduces the time and expertise necessary to tune the controller for satisfactory tracking performance. GRA

N92-19289*# Houston Univ., TX. Dept. of Electrical Engineering.

SELF-ORGANIZATION VIA ACTIVE EXPLORATION IN ROBOTIC APPLICATIONS Final Report

H. Ogmen and R. V. Prakash Feb. 1992 59 p

(Grant NAG9-473)

(NASA-CR-189537; NAS 1.26:189537) Avail: NTIS HC/MF A04 CSCL 13I

We describe a neural network based robotic system. Unlike traditional robotic systems, our approach focussed on non-stationary problems. We indicate that self-organization capability is necessary for any system to operate successfully in a non-stationary environment. We suggest that self-organization should be based on an active exploration process. We investigated neural architectures having novelty sensitivity, selective attention, reinforcement learning, habit formation, flexible criteria categorization properties and analyzed the resulting behavior (consisting of an intelligent initiation of exploration) by computer simulations. While various computer vision researchers acknowledged recently the importance of active processes (Swain and Stricker, 1991), the proposed approaches within the new framework still suffer from a lack of self-organization (Aloimonos and Bandyopadhyay, 1987; Bajcsy, 1988). A self-organizing, neural network based robot (MAVIN) has been recently proposed (Baloch and Waxman, 1991). This robot has the capability of position, size rotation invariant pattern categorization, recognition and pavlovian conditioning. Our robot does not have initially invariant processing properties. The reason for this is the emphasis we put on active exploration. We maintain the point of view that such invariant properties emerge from an internalization of exploratory sensory-motor activity. Rather than coding the equilibria of such mental capabilities, we are seeking to capture its dynamics to understand on the one hand how the emergence of such invariances is possible and on the other hand the dynamics that lead to these invariances. The second point is crucial for an adaptive robot to acquire new invariances in non-stationary environments, as demonstrated by the inverting glass experiments of Helmholtz. We will introduce Pavlovian conditioning circuits in our future work for the precise objective of achieving the generation, coordination, and internalization of sequence of actions. Author

N92-19334# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

COMPARISON OF POINTING CONTROL SYSTEMS UTILIZING DAHL AND COULOMB FRICTION MODEL COMPENSATION M.S. Thesis

Whitney J. Hulett Dec. 1991 101 p

(AD-A244266; AFIT/GAE/ENY/91D-16) Avail: NTIS HC/MF A06 CSCL 19/5

Bearing friction can be accurately modeled using the Coulomb friction model, provided the bearing is running. In an application where the bearing is rotated only a very small amount, the bearing does not actually rotate. Instead, the bearing undergoes plastic deformation. A nonlinear friction model was developed by P. R. Dahl of the Aerospace Corporation in the late sixties which addresses this region of placticity or compliance zone. Two friction compensation schemes for a single axis position servomechanism were developed and compared in this study. The first compensator was an integral control regulator/estimator which used the Coulomb friction model. The second, more complicated compensator, was an extended Kalman filter (EKF) design which used the DAHL friction model. The compensator designs were simulated using ProMatlab. Comparisons were made of the time response characteristics to determine if any increases in performance were worth the added complexity of the Dahl model EKF controller. Author (GRA)

N92-19376*# Texas Univ., Austin. Dept. of Mechanical Engineering.

CONCEPTUAL DESIGN OF EQUIPMENT TO EXCAVATE AND TRANSPORT REGOLITH FROM THE LUNAR MARIA Final Design Report

Mark Detwiler, Chee Seng Foong, and Catherine Stocklin 1990 145 p

(Contract NASw-4435)

(NASA-CR-189972; NAS 1.26:189972) Avail: NTIS HC/MF A07 CSCL 13I

NASA hopes to have a manned lunar outpost completed by 2005. In order to establish the base, regolith must be excavated from the lunar surface. Regolith will be used as a source for life-supporting elements and as radiation shielding for the lunar outpost. The design team from the University of Texas at Austin designed excavation and transportation equipment for initial operations of the lunar base. The design team also characterized the elements to be found in the regolith and determined the power required to excavate regolith. The characterization of the soil was based on a literature review of lunar geography. Power requirements for excavation were developed by adapting terrestrial equations for excavation power requirements and adapting them to lunar soil conditions. The design of the excavation and transportation equipment was broken into three functions: loosing, collecting, and transporting. A scarifier was selected to loosen, a bucket was selected to collect, and a load-haul system was selected to transport. The functions are powered by a modular fuel cell powered vehicle that provides power for motion of the equipment. Author

N92-19378*# Texas Univ., Austin. Dept. of Mechanical Engineering.

DESIGN OF EQUIPMENT FOR LUNAR DUST REMOVAL Final Report

Lacy Belden, Kevin Cowan, Hank Kleespies, Ryan Ratliff, Oniell Shah, and Kevin Shelburne 1991 92 p

(Contract NASw-4435)

(NASA-CR-190014; NAS 1.26:190014) Avail: NTIS HC/MF A05 CSCL 13I

NASA has a long range goal of constructing a fully equipped, manned lunar base on the near side of the moon by the year 2015. During the Apollo Missions, lunar dust coated and fouled equipment surfaces and mechanisms exposed to the lunar environment. In addition, the atmosphere and internal surfaces of the lunar excursion module were contaminated by lunar dust which was brought in on articles passed through the airlock. Consequently, the need exists for device or appliance to remove lunar dust from surfaces of material objects used outside of the proposed lunar habitat. Additionally, several concepts were investigated for preventing the accumulation of lunar dust on mechanisms and finished surfaces. The character of the dust and the lunar environment present unique challenges for the removal of contamination from exposed surfaces. In addition to a study of lunar dust adhesion properties, the project examines the use of various energy domains for removing the dust from exposed surfaces. Also, prevention alternatives are examined for systems exposed to lunar dust. A concept utilizing a pressurized gas is

presented for dust removal outside of an atmospherically controlled environment. The concept consists of a small astronaut/robotic compatible device which removes dust from contaminated surfaces by a small burst of gas. Author

N92-19473# Sandia National Labs., Albuquerque, NM.
STATIC LOAD TESTING OF A HELIOSTAT DRIVE
J. W. Grossman Oct. 1991 60 p
(Contract DE-AC04-76DP-00789)
(DE92-003952; SAND-90-2624) Avail: NTIS HC/MF A04

A drive designed and built by the Solar Power Engineering Company (SPECO), for its large area heliostat, failed under high wind loads during a winter storm. This report details the testing and analysis done to verify the load capabilities of the rebuilt heliostat drive. Changes in design and improvements in fabrication resulted in a usable drive. DOE

N92-19493*# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
AUTONOMOUS SPACE PROCESSOR FOR ORBITAL DEBRIS Summary Report, 1990 - 1991
Kumar Ramohalli, Micky Marine, James Colvin, Richard Crockett, Lee Sword, Jennifer Putz, and Sheri Woelfle 1991 66 p Presented at the 7th Annual Summer Conference, Coccoa Beach, FL, 17-21 Jun. 1991 Original contains color illustrations
(Contract NASw-4435)
(NASA-CR-189986; NAS 1.26:189986) Avail: NTIS HC/MF A04; 2 functional color pages CSCL 13I

The development of an Autonomous Space Processor for Orbital Debris (ASPOD) was the goal. The nature of this craft, which will process, in situ, orbital debris using resources available in low Earth orbit (LEO) is explained. The serious problem of orbital debris is briefly described and the nature of the large debris population is outlined. The focus was on the development of a versatile robotic manipulator to augment an existing robotic arm, the incorporation of remote operation of the robotic arms, and the formulation of optimal (time and energy) trajectory planning algorithms for coordinated robotic arms. The mechanical design of the new arm is described in detail. The work envelope is explained showing the flexibility of the new design. Several telemetry communication systems are described which will enable the remote operation of the robotic arms. The trajectory planning algorithms are fully developed for both the time optimal and energy optimal problems. The time optimal problem is solved using phase plane techniques while the energy optimal problem is solved using dynamic programming. Author

N92-19494 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. for Problems of Power Modelling.
ARC WELDING TRAINING DEVICES BASED ON PROGRAMMING LOGIC [DUGOVYE SVAROCHNYE TRENAZHERY NA OSNOVE PROGRAMMIRUEMOI LOGIKI]
V. V. Vasilev, S. N. Daniliak, G. V. Davydova, and V. V. Tkachenko 1990 42 p In RUSSIAN
Copyright Avail: Issuing Activity

This article focuses on questions of arc welding training device design based on programming logic. A design for a microprocessor-based low-amp arc welding training device is proposed. Questions concerning the composition of a simulated welding process are investigated. The mathematical model describing the work of the given transducer is considered. A description of the programmatic safety of the training device is given. Transl. by L.K.H.

N92-19495*# Maryland Univ., College Park. Systems Research Center.
THE WALKING ROBOT PROJECT Final Report
P. Williams, E. Sagraniching, M. Bennett, and R. Singh 1991 96 p Prepared in cooperation with Harvard Univ., Cambridge, MA
(Contract NASw-4435; NSF DCD-88-03012)
(NASA-CR-189982; NAS 1.26:189982) Avail: NTIS HC/MF A05 CSCL 13I

A walking robot was designed, analyzed, and tested as an intelligent, mobile, and a terrain adaptive system. The robot's design was an application of existing technologies. The design of the six legs modified and combines well understood mechanisms and was optimized for performance, flexibility, and simplicity. The body design incorporated two tripods for walking stability and ease of turning. The electrical hardware design used modularity and distributed processing to drive the motors. The software design used feedback to coordinate the system and simple keystrokes to give commands. The walking machine can be easily adapted to hostile environments such as high radiation zones and alien terrain. The primary goal of the leg design was to create a leg capable of supporting a robot's body and electrical hardware while walking or performing desired tasks, namely those required for planetary exploration. The leg designers intent was to study the maximum amount of flexibility and maneuverability achievable by the simplest and lightest leg design. The main constraints for the leg design were leg kinematics, ease of assembly, degrees of freedom, number of motors, overall size, and weight. Author

N92-19508# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ROBUST GRASP DESIGN USING GRASP FORCE FOCUS POSITIONING M.S. Thesis
Freddie D. Zayas 12 Dec. 1991 209 p
(AD-A243875; AFIT/GAE/ENY/91D-29) Avail: NTIS HC/MF A10 CSCL 12/9

A three-finger precision grasp is used to rotate a cylindrical object about a threaded post. Three fingered grasps are unique in that the homogeneous solution for the contact forces produces a grasp force focus. Mapping of focus points which meet grasp stability and joint torque criteria results in a usable focus region. The effects of applied torque, contact location, and object position and orientation on usable regions are presented. Stability behavior about the region is also examined. Results are used to demonstrate a technique for robust grasp design. The versatility of robotic hands permit fine motion manipulation on a wide variety of objects. This distinct advantage of manipulating an assortment of objects eliminates the need for multiple custom end effectors. Today's economy demands that new technology advancements lead to operational systems which are efficient, robust, and low cost. Perhaps the most desirable characteristic for current technology is the ability to perform a wide variety of tasks with a single system configuration. Robotic systems configured with articulated hands have the potential to satisfy each of these attributes and more. GRA

N92-19616 Rice Univ., Houston, TX.
A NEW METHOD FOR SOLVING THE KINEMATICS OF MULTIFINGERED GRASPING AND GENERAL REDUNDANT MANIPULATORS: A TASK ORIENTED APPROACH Ph.D. Thesis
Yu-Che Chen 1991 221 p
Avail: Univ. Microfilms Order No. DA9136010

A new approach to intelligent multifingered grasping and redundant arm manipulation is presented. A computationally efficient and physically meaningful model is proposed for the planning of grasp positions, the determination of squeezing finger forces, and the visualization of the motions of redundant arms. The main thrust is the use of mechanical equivalent force/moment systems. These systems allow the decomposition of each finger force into a normal and a tangential component. Using this decomposition, the contribution can be visualized of each finger force by the resultant force and moment required to manipulate a grasped object. Next, an efficient method is provided for analyzing the inverse kinematic problem of redundant manipulators. The method is based on fully using the directional properties of the columns of the Jacobian matrix which relates the joint velocities of the arm and the end effector velocities. Motions of a redundant manipulator are analyzed through its upper arm's motion and wrist's motion and the Jacobian matrix is partitioned accordingly. It is shown that the motion of the upper arm and the wrist can be

evaluated separately and in parallel through this vectorized approach. Dissert. Abstr.

N92-19618 Rice Univ., Houston, TX.
DEVELOPMENT OF A LARGE SPACE ROBOT: A MULTI-SEGMENT APPROACH Ph.D. Thesis
Reginald Bruce Berka 1991 190 p
Avail: Univ. Microfilms Order No. DA9135998

A multi-segment robot is developed as a concept for use in space-based construction operations. The multi-segment robot is envisioned as a member of a class of large space robots, or space cranes, used in the space assembly of advanced spacecraft. The problems that arise when the requisite robot size becomes large are explored. The unique capabilities of the multi-segment robot are discussed. The multi-segment robot involves a collection of common bodies, or segments, that are pinned together to form a snake-like configuration. A degree of freedom representing rotation is retained at each pinned connection. Reaction flywheels are suspended within each segment and provide the control to position each segment. Algorithms are developed to position this serpentine robot to a prescribed location and orientation. The first algorithm is used to compute a general shape, based on a constrained polynomial function, that locates the robot tip at the proper position. Next, an algorithm is developed that is used to position the discrete bodies along the shape function and determines their relative positions. An n-body simulation program is developed based on Newton-Euler equations of motion for the robot. The simulation is used to develop the robot control strategy, to verify its performance, and to size prototype hardware. Two cases are analyzed to study the dexterity of the proposed configuration. Dissert. Abstr.

N92-19638# Los Alamos National Lab., NM.
FUEL CELL POWER PLANTS FOR TRANSPORTATION APPLICATIONS
J. R. Huff 1991 7 p Presented at the 7th Annual Battery Conference on Applications, Long Beach, CA, 21-23 Jan. 1992
(Contract W-7405-eng-36)
(DE92-004840; LA-UR-91-3900; CONF-920151-2) Avail: NTIS HC/MF A02

Over the past 35 years, the transportation sector has accounted fr approximately 25 percent of the total gross energy consumption in the United States. As the largest energy user in the United States, transportation accounts for approximately 66 percent of the country's current petroleum consumption. Fuel cell power plants using nonpetroleum fuels such as methanol could significantly reduce US dependency on petroleum resources. They offer the additional advantage of minimal air pollution, thereby, addressing another issue of major concern in the US. Fuel cell power plant use in city buses and other vehicles is being explored in a number of US Department of Energy and industrial programs that are described in this paper. DOE

N92-19685*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
ORBITAL TRANSFER ROCKET ENGINE TECHNOLOGY PROGRAM: SOFT WEAR RING SEAL TECHNOLOGY Final Technical Report, 1985 - 1990
Brian W. Lariviere 14 Feb. 1992 191 p Original contains color illustrations
(Contract NAS3-23773)
(NASA-CR-189055; NAS 1.26:189055; RI/RD90-214) Avail: NTIS HC/MF A09; 2 functional color pages CSCL 11A

Liquid oxygen (LOX) compatibility tests, including autogenous ignition, promoted ignition, LOX impact tests, and friction and wear tests on different PV products were conducted for several polymer materials as verification for the implementation of soft wear ring seals in advanced rocket engine turbopumps. Thermoplastics, polyimide based materials, and polyimide-imide base materials were compared for oxygen compatibility, specific wear coefficient, wear debris production, and heat dissipation mechanisms. A thermal model was generated that simulated the frictional heating input and calculated the surface temperature and temperature distribution within the seal. The predictions were compared against measured values. Heat loads in the model were varied to better match the test data and determine the difference between the measured and the calculated coefficients of friction. Author

N92-19825# Southwest Research Inst., San Antonio, TX.
CONTROL OF BENZENE EMISSIONS FROM LIGHT-DUTY MOTOR VEHICLES Final Report
M. J. Heimrich Jun. 1991 269 p Sponsored in part by California State Air Resources Board, Sacramento
(Contract ARB-A6-204-32)
(PB92-102631; SwRI-08/1815; ARB-R-91/467) Avail: NTIS HC/MF A12 CSCL 13B

Several strategies to reduce the total amount of exhaust and evaporative benzene emissions from light-duty gasoline-fueled vehicles were investigated. A literature search was performed to determine automotive benzene emission levels and technologies for benzene emission control. Laboratory vehicle emission tests were performed to demonstrate benzene control technologies. Exhaust benzene emission control was addressed by reducing total hydrocarbon emissions (including benzene), and focused on developing strategies for specifically controlling the high level of cold-start emissions. Catalyst formulations were investigated for improved benzene conversion efficiencies. High temperature catalysts were close-coupled to the exhaust manifold to promote quicker catalyst light-off. Zeolite molecular sieves were evaluated for evaporative emission control and results were compared to those using conventional coal- and wood-based activated carbon. A cold-start hydrocarbon collection system was developed. Author

N92-19861# Southwest Research Inst., San Antonio, TX. Engine, Fuel and Vehicle Research Div.
NATURAL GAS ENGINE TECHNOLOGY ADVANCEMENTS Annual Report, Oct. 1989 - Dec. 1990
S. R. King Aug. 1991 129 p
(Contract GRI-5089-293-1848)
(PB92-110097; SwRI-3178A-1; GRI-91/0149) Avail: NTIS HC/MF A07 CSCL 13I

The initial research efforts focused on durability issues such as ring/liner wear, valve recession, and lubricating oil life relevant to stationary gas engine applications. Following input from the Gas Engine Technology Advisory Committee, the focus was changed and research was initiated to understand the effect of natural gas fuel composition on engine performance and emissions; gas engine controls, sensors, and actuators; and catalyst evaluations. The durability research was reduced in scope to just ring/liner wear and investigating the need for a lubricating oil specification for natural gas. Accomplishments during the first 15 months of the project are reported. Author

N92-19915# Bertin et Cie., Plaisir (France).
ACTIVE VIBRATION CONTROL OF INDUSTRIAL ROBOTS: FINAL RESULTS OF ESPRIT PROJECT SACODY
Jean-Luc Faillot 1991 17 p Presented at the Conference Europeenne d'Automatique (EEC '91), Saint Martin d'Heres, France, 2-7 Jul. 1991
(ETN-92-90752) Avail: NTIS HC/MF A03

Mechanical manipulators exhibit, when submitted to high speed and acceleration rates, vibrations which limit their performances and generate additional stresses on their structure. Up to now, robot designers have solved this problem by building stiff structures, yielding bulky, energy consuming, and expensive robots. The basic idea of ESPRIT project 1561, called SACODY, was to propose an efficient alternative to this solution, relying on an intensive use of computer aided engineering methods such as model analysis and dynamic modeling. To enable the design of high performance and cost effective robots, the robot designers must now turn to an advanced robot control to avoid structural vibrations. SACODY succeeded in demonstrating on a spot welding robot an antivibration robot control running on an industrial hardware. Beyond a completely new methodology of servomechanism control, enabling a tremendous improvement on the behavior and

performance of the industrial robots, the outcomes of SACODY are: a commercial software package for computer aided dynamic analysis; a software package of the dynamic simulation of flexible multibody systems; a high performance servolevel hardware now incorporated in a commercialized robot control; and prototypes of efficient sensor systems for robot testing. The project background is recalled and the project outcomes through their application to the project demonstrator are described. ESA

N92-19937# Sandia National Labs., Albuquerque, NM.
EXPERIMENTS IN ROBOTIC SENSORI-MOTOR CONTROL DURING GRASP
S. A. Stansfield Sep. 1991 21 p
(Contract DE-AC04-76DP-00789)
(DE92-005384; SAND-91-1379) Avail: NTIS HC/MF A03

This paper presents a series of experiments in robotic sensori-motor control during grasping. The work utilizes a multifingered, dextrous robot hand equipped with a fingertip force sensor to explore dynamic grasp force adjustment during manipulation. The work is primarily concerned with the relationship between the weight of an object and the grasp force required to lift it. Too weak a grasp is unstable and the object will slip from the hand. Too strong a grasp may damage the object and/or the manipulator. An algorithm is presented which uses tactile information from the sensor to dynamically adjust the grasp force during lift. It is assumed that there is no a priori knowledge about the object to be manipulated. The effects of different arm/hand postures and object surfaces is explored. Finally, the use of sensory data to detect unexpected object motion and to signal transitions between manipulation phases - with the coincident triggering of new motor programs - is investigated. DOE

N92-19991# Southwest Research Inst., San Antonio, TX. Automotive Products and Emissions Research Div.
LOW EMISSION CATALYSTS FOR NATURAL GAS ENGINES Topical Report, Nov. 1989 - May 1991
J. J. White Aug. 1991 106 p
(Contract GRI-5089-293-1848)
(PB92-101468; SWRI-3178-2-2; GETA-91-09; GRI-91/0214)
Avail: NTIS HC/MF A06 CSCL 13I

The objective was to define the state-of-the-art in natural gas fueled engine emission control catalyst technology. Methane oxidation activity was a primary focus due to the known difficulty of catalytic methane oxidation and the resulting implications in the event of a total hydrocarbon standard. Detailed performance information was to be generated for both 'lean burn' and a stoichiometric engine. Problems particular to natural gas engine 'after treatment' were to be identified. Selected catalysts were to be reevaluated following limited aging to evaluate catalyst performance durability. Results were to be shared with both engine and catalyst manufacturers to foster communications regarding engine applications and to help define directions for future catalyst research and development. Author

N92-19311*# Clemson Univ., SC. Dept. of Electrical and Computer Engineering.
MODELING AND CONTROL OF THE AUTOMATED RADIATOR INSPECTION DEVICE
Darren Dawson *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 141-170 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 13I

N92-19312*# Oklahoma State Univ., Stillwater. Dept. of Electrical and Computer Engineering.
FRAME SHIFT/WARP COMPENSATION FOR THE ARID ROBOT SYSTEM
Carl D. Latino *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 171-209 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 13I

N92-19321*# State Univ. of New York, Farmingdale. Dept. of Mechanical Engineering.
GENERIC TECHNIQUES FOR THE CALIBRATION OF ROBOTS WITH APPLICATION OF THE 3-D FIXTURES AND STATISTICAL TECHNIQUE ON THE PUMA 500 AND ARID ROBOTS
Hazem Tawfik *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 469-506 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 13I

N92-19323*# North Carolina Univ., Charlotte. Dept. of Engineering Technology.
STUDY AND DEVELOPMENT OF AN AIR CONDITIONING SYSTEM OPERATING ON A MAGNETIC HEAT PUMP CYCLE
Pao-Lien Wang *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 535-553 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-19108# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.
QUALITY ASSURANCE REQUIREMENTS FOR ESA SPACE SYSTEMS
Feb. 1991 83 p
(ESA-PSS-01-20-Issue-2; ISSN-0379-4059; ETN-92-90751)
Copyright Avail: NTIS HC/MF A05

The quality assurance (QA) requirements which implement the European Space Agency (ESA) QA Policy and which are applicable to ESA Space Systems are defined. QA program management is described. QA general requirements and QA specific requirements for design and development, procurement, manufacturing, assembly, integration and test, and acceptance and delivery are presented. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N92-19170# Army Armament Research, Development and Engineering Center, Watervliet, NY.
MATERIALS ANALYSIS OF A FATIGUE TESTING MANDREL Final Report
M. Brodsky, J. Senick, and G. Young Nov. 1991 36 p
(AD-A244344; ARCCB-TR-91034) Avail: NTIS HC/MF A03
CSCL 13/9

A materials characterization and failure analysis were performed on a fatigue testing mandrel that failed after a total of 5061 cycles. The mandrel was reportedly composed of marage 250 grade steel, and the raw material was specified to be delivered in the solution-annealed condition. Subsequent processing was to include rough machining to the approximate mandrel dimensions, an aging treatment at 900 F for four hours, and finish machining. GRA

N92-19197# Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
INELASTIC DEFORMATION AND FAILURE ANALYSIS OF FILAMENT-WOUND COMPOSITE STRUCTURES Final Report, 1 May 1988 - 31 Aug. 1991
Wan-Lee Yin, Gerald A. Wempner, and Zhizhong Fei Oct. 1991 262 p
(Contract DAAL03-88-K-0071)
(AD-A244161; ARO-25400.7-EG) Avail: NTIS HC/MF A12 CSCL 13/13

Several fundamental problems associated with the mechanical behavior and failure of filament-wound composite structures are studied. Available experimental results on pressure testing of filament-wound composite tubes are analyzed to formulate the incremental constitutive relations of a filament layer under deformations with a large shear strain, and to correlate the intrinsic strain paths preceding the failure of the filament layer with the various failure modes of the structure. Implication of the results to the analysis of filament-wound structures is described. Micromechanical analyses using the boundary element method are conducted to determine the composite gross elastic moduli in terms of the constituent properties, and to study the fracture mechanics problems associated with fiber-matrix debonding and oblique matrix crack between adjacent fibers. Analytical models of delamination failure in filament-wound structures and composite laminates are proposed and the separation and postbuckling problems of helical and two-dimensional delaminations are extensively investigated. A variational method using stress functions is developed to obtain efficient and accurate solutions of free-edge interlaminar stresses in composite structures. GRA

N92-19237*# State Univ. of New York, Buffalo. Dept. of Civil Engineering.
DEVELOPMENT OF AN INTEGRATED BEM APPROACH FOR HOT FLUID STRUCTURE INTERACTION
G. F. Dargush, P. K. Banerjee, and Y. Shi Oct. 1991 158 p
(Grant NAG3-712)
(NASA-CR-187236; NAS 1.26:187236) Avail: NTIS HC/MF A08 CSCL 20K

The development of a comprehensive fluid-structure interaction capability within a boundary element computer code is described. This new capability is implemented in a completely general manner, so that quite arbitrary geometry, material properties and boundary conditions may be specified. Thus, a single analysis code can be used to run structures-only problems, fluids-only problems, or the combined fluid-structure problem. In all three cases, steady or transient conditions can be selected, with or without thermal effects. Nonlinear analyses can be solved via direct iteration or by employing a modified Newton-Raphson approach. A number of detailed numerical examples are included at the end of these two sections to validate the formulations and to emphasize both the accuracy and generality of the computer code. A brief review of the recent applicable boundary element literature is included for completeness. The fluid-structure interaction facility is discussed. Once again, several examples are provided to highlight this unique capability. A collection of potential boundary element applications that have been uncovered as a result of work related to the present grant is given. For most of those problems, satisfactory analysis techniques do not currently exist. Author

N92-19258*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIMENTAL VALIDATION OF STRUCTURAL OPTIMIZATION METHODS
Howard M. Adelman Jan. 1992 36 p
(NASA-TM-104203; NAS 1.15:104203) Avail: NTIS HC/MF A03 CSCL 20K

The topic of validating structural optimization methods by use of experimental results is addressed. The need for validating the methods as a way of effecting a greater and an accelerated acceptance of formal optimization methods by practicing engineering designers is described. The range of validation strategies is defined which includes comparison of optimization results with more traditional design approaches, establishing the accuracy of analyses used, and finally experimental validation of the optimization results. Examples of the use of experimental results to validate optimization techniques are described. The examples include experimental validation of the following: optimum design of a trussed beam; combined control-structure design of a cable-supported beam simulating an actively controlled space structure; minimum weight design of a beam with frequency constraints; minimization of the vibration response of helicopter rotor blade; minimum weight design of a turbine blade disk; aeroelastic optimization of an aircraft vertical fin; airfoil shape optimization for drag minimization; optimization of the shape of a hole in a plate for stress minimization; optimization to minimize beam dynamic response; and structural optimization of a low vibration helicopter rotor. Author

N92-19277*# General Electric Co., Cincinnati, OH. Aircraft Engine Business Group.
ENGINE STRUCTURES MODELING SOFTWARE SYSTEM (ESMOSS) Final Report
Oct. 1991 84 p
(Contract NAS3-22767)
(NASA-CR-187227; NAS 1.26:187227) Avail: NTIS HC/MF A05 CSCL 20K

Engine Structures Modeling Software System (ESMOSS) is the development of a specialized software system for the construction of geometric descriptive and discrete analytical models of engine parts, components, and substructures which can be transferred to finite element analysis programs such as NASTRAN. The NASA Lewis Engine Structures Program is concerned with the development of technology for the rational structural design and analysis of advanced gas turbine engines with emphasis on advanced structural analysis, structural dynamics, structural aspects of aeroelasticity, and life prediction. Fundamental and common to all of these developments is the need for geometric and analytical model descriptions at various engine assembly levels which are generated using ESMOSS. Author

N92-19353*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
SCALING EFFECTS IN ANGLE-PLY LAMINATES
Sotiris Kellas and John Morton Washington NASA. Langley Research Center Feb. 1992 58 p
(Contract NAS1-18471)
(NASA-CR-4423; NAS 1.26:4423) Avail: NTIS HC/MF A04 CSCL 20K

The effect of specimen size upon the response and strength of +/- 45 degree angle-ply laminates was investigated for two graphite fiber reinforced plastic systems and several stacking sequences. The first material system was a brittle epoxy based system, AS4 fibers in 3502 epoxy, and the second was a tough thermoplastic based system, AS4 fibers in PEEK matrix. For the epoxy based system, two generic +/- 45 degree lay-ups were studied: (+45 degrees sub n/-45 degrees sub n) sub 2S (blocked plies), and (+45 degrees/-45 degrees) sub 2nS, for n=1 and 2. The in-plane dimensions of the specimens were varied such that the width/length relationship was 12.7 x n/127 x n mm, for m=1, 2, 3, or 4. It is shown that the stress/strain response and the ultimate strength of these angle-ply laminates depends on the laminate thickness and the type of generic lay-up used. Furthermore, it is shown that first ply failure occurs in the surface plies as a result of normal rather than shear stresses. The implications of the experimental findings upon the validity of the +/- 45 degree tensile test which is used to determine the in-plane shear response of unidirectional composites are discussed. Author

N92-19355*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
STRUCTURAL DETERMINISTIC SAFETY FACTORS SELECTION CRITERIA AND VERIFICATION
V. Verderaime Feb. 1992 50 p

(NASA-TP-3203; M-683; NAS 1.60:3203) Avail: NTIS HC/MF A03 CSCL 20K

Though current deterministic safety factors are arbitrarily and unaccountably specified, its ratio is rooted in resistive and applied stress probability distributions. This study approached the deterministic method from a probabilistic concept leading to a more systematic and coherent philosophy and criterion for designing more uniform and reliable high-performance structures. The deterministic method was noted to consist of three safety factors: a standard deviation multiplier of the applied stress distribution; a K-factor for the A- or B-basis material ultimate stress; and the conventional safety factor to ensure that the applied stress does not operate in the inelastic zone of metallic materials. The conventional safety factor is specifically defined as the ratio of ultimate-to-yield stresses. A deterministic safety index of the combined safety factors was derived from which the corresponding reliability proved the deterministic method is not reliability sensitive. The bases for selecting safety factors are presented and verification requirements are discussed. The suggested deterministic approach is applicable to all NASA, DOD, and commercial high-performance structures under static stresses. Author

N92-19361# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Section Construction Metallique.

CONTRIBUTION TO THE UNDERSTANDING OF FATIGUE RESISTANCE OF WELDED ASSEMBLIES [CONTRIBUTION A LA CONNAISSANCE DE LA RESISTANCE A LA FATIGUE D'ASSEMBLAGES SOUDES]

M. Hubert (Ministere de l'Equipment et des Transports, Brussels, Belgium) and E. Piraprez Feb. 1991 54 p In FRENCH Sponsored by Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture

(CRIF-MT-181; ETN-92-90821) Avail: NTIS HC/MF A04

Fatigue tests are carried out on two types of assemblies often encountered in metal framing systems. These assembly types require long and costly attention during assembly. The fatigue tests are carried out to determine whether so much time and care is actually necessary. The first type of assembly considered is a double T beam made using full penetration welding on which the weld edges have been cut. These welds are, to date, only classified as highly fatigue resistant if they are carried out in one continuous weld. A beam within a box assembled with two angle joists is the other type of assembly considered. The results of the fatigue tests indicate that special care is not required for the double T beam weld. In the case of the box weld, one heavy angle joist is shown to be as resistant as two smaller joists. ESA

N92-19369# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

A COMPARISON OF FRACTIONAL ORDER TIME DERIVATIVE MODELS OF THE VISCOELASTIC STRESS RELATIONS IN THERMORHEOLOGICALLY COMPLEX MATERIALS M.S. Thesis

Victor B. Chambers Dec. 1991 110 p

(AD-A243971; AFIT/GAE/ENY/91D-23) Avail: NTIS HC/MF A06 CSCL 20/11

The purpose of this thesis was to examine the viscoelastic behavior of thermorheologically complex materials, a typical example of which is a soft, rubbery material. Materials such as these are very useful in damping vibrations in structures, but the relaxation moduli of these materials change significantly with temperature and frequency. In the case of space structures applications where temperatures vary greatly and a stable platform is necessary, a method to predict this changing modulus is needed. The original approach was to validate a previously developed viscoelastic model, but the task expanded to include extending the model to materials with two transitions from a low modulus value to a higher value and applying thermodynamic principles to validate the extended model. GRA

N92-19384# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

FINITE ELEMENT ANALYSIS OF A RIVETED REPAIR ON A CURVED COMPOSITE PANEL M.S. Thesis

Scott A. Hamilton Dec. 1991 118 p

(AD-A243916; AFIT/GAE/ENY/91D-3) Avail: NTIS HC/MF A06 CSCL 13/13

To analyze the current Aircraft Battle Damage Repair (ABDR) Techniques, a finite element model (FEM) of a curved composite panel with a center cutout section was developed and verified against previously obtained modal test results. The FEM was modified using different methods to exhibit the effects of riveting on an aluminum patch to repair the section. The different methods were contrasted against each other and previously obtained modal test results. The panel, a (0/-45/+45/90) sub s layup of AS4/3501 graphite epoxy measuring 12 inches in height and 12.19 inches across its arc length with a 2 by 4 inch cutout at a 0, +45, -45, or 90 degree orientation was modeled using MSC/NASTRAN QUAD4 elements. The first repair modeling method used a mixture of the aluminum and composite panel properties to represent the overlap region of the patch. The second method used ELAS2 and CONM2 elements to model the rivets, and modeled the panel and the patch separately. GAP elements prevented the patch from deforming through the panel. For the mixed properties, the mode shapes agreed with experimental data at lower frequencies but were distorted at the higher ones and were regularly 5-25 percent high. Modeling the rivets individually produced matching mode shapes and frequencies regularly within 5 percent of experimental values. GRA

N92-19404*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

PRACTICAL THEORIES FOR SERVICE LIFE PREDICTION OF CRITICAL AEROSPACE STRUCTURAL COMPONENTS

William L. Ko, Richard C. Monaghan, and Raymond H. Jackson Mar. 1992 27 p

(NASA-TM-4354; H-1760; NAS 1.15:4354) Avail: NTIS HC/MF A03 CSCL 20K

A new second-order theory was developed for predicting the service lives of aerospace structural components. The predictions based on this new theory were compared with those based on the Ko first-order theory and the classical theory of service life predictions. The new theory gives very accurate service life predictions. An equivalent constant-amplitude stress cycle method was proposed for representing the random load spectrum for crack growth calculations. This method predicts the most conservative service life. The proposed use of minimum detectable crack size, instead of proof load established crack size as an initial crack size for crack growth calculations, could give a more realistic service life. Author

N92-19479# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

THE USE OF A HIGHER ORDER KINEMATIC RELATIONSHIP ON THE ANALYSIS OF CYLINDRICAL COMPOSITE PANELS M.S. Thesis

Kathleen V. Tighe Dec. 1991 259 p

(AD-A243866) Avail: NTIS HC/MF A12 CSCL 13/13

An analytical study was performed to determine the critical buckling loads and natural frequencies for composite cylindrical shells, including transverse shear effects and constant through the thickness direct strain epsilon sub z. A linearized form of Sanders shell equations are derived, including a parabolic transverse shear strain distribution. Higher order laminate constitutive relations are developed. Hamilton's Principle is applied to derive five partial differential equations of motion and the associated boundary conditions, which are then solved using the Galerkin technique. Ply layups of (0/90), (45/-45), and (0/45/-45/90) were investigated under three boundary conditions, simply supported, clamped, and a combination simple-clamped. Symmetric and nonsymmetric laminates were investigated. Curvature is shown to have an important effect on all panels investigated, due to membrane and bending coupling. Buckling

loads for deeper shells are significantly higher than for flat plates. The effect on frequencies is not as great. Comparisons between various ply layups and boundaries show results are greatly dependent on the shell geometry, curvature, and boundary conditions. GRA

N92-19481# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FAILURE CHARACTERISTICS OF SCS-6/Ti-24Al-11Nb COMPOSITE WITH A CIRCULAR HOLE AT ROOM AND ELEVATED TEMPERATURES M.S. Thesis
Joseph E. Overbeck Dec. 1991 114 p
(AD-A243869; AFIT/GAE/ENY/91D-8) Avail: NTIS HC/MF A06 CSCL 20/11

Off-axis loading of eight ply, unidirectional specimens with and without a circular hole determined the ultimate tensile strength of SCS-6/Ti-24Al-11Nb composite at temperatures of 25 C and 650 C and fiber orientations of 0 degrees, 15 degrees, 45 degrees. Longitudinal moduli of the tested orientations compared closely to the rule of mixtures calculated values, and strengths compared closely to those predicted by the Tsai-Wu failure theory. The small diameter hole does not act as a stress concentrator, but merely reduces the material's strength in proportion to area loss. This result differs from those predicted by linear finite element analysis and orthotropic stress concentration theory. Radiography, used to detect damage prior to failure, showed no fiber breakage nor matrix cracking. Microscopic examination of the fracture surfaces indicates a weak fiber/matrix interface bond at both room and elevated temperatures. Brittle fracture of fibers and matrix with little fiber pull out occurs at room temperature, while brittle fiber fracture and ductile matrix fracture with greater fiber pull out occurs at elevated temperatures. GRA

N92-19492*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EIGENSYSTEM REALIZATION ALGORITHM MODAL IDENTIFICATION EXPERIENCES WITH MINI-MAST
Richard S. Pappa, Axel Schenk, and Christopher Noll (Lockheed Engineering and Sciences Co., Hampton, VA.) Feb. 1992 43 p
(NASA-TM-4307; NAS 1.15:4307) Avail: NTIS HC/MF A03 CSCL 20K

This paper summarizes work performed under a collaborative research effort between the National Aeronautics and Space Administration (NASA) and the German Aerospace Research Establishment (DLR, Deutsche Forschungsanstalt fur Luft- und Raumfahrt). The objective is to develop and demonstrate system identification technology for future large space structures. Recent experiences using the Eigensystem Realization Algorithm (ERA), for modal identification of Mini-Mast, are reported. Mini-Mast is a 20 m long deployable space truss used for structural dynamics and active vibration-control research at the Langley Research Center. A comprehensive analysis of 306 frequency response functions (3 excitation forces and 102 displacement responses) was performed. Emphasis is placed on two topics of current research: (1) gaining an improved understanding of ERA performance characteristics (theory vs. practice); and (2) developing reliable techniques to improve identification results for complex experimental data. Because of nonlinearities and numerous local modes, modal identification of Mini-Mast proved to be surprisingly difficult. Methods were available, ERA, for obtaining detailed, high-confidence results. Author

N92-19500*# Textron Bell Aerospace Co., Buffalo, NY.
SLAVE FINITE ELEMENTS FOR NONLINEAR ANALYSIS OF ENGINE STRUCTURES, VOLUME 1 Final Report
S. Gellin Oct. 1991 83 p
(Contract NAS3-23279)
(NASA-CR-187224; NAS 1.26:187224; BAT-2538-953002-Vol-1) Avail: NTIS HC/MF A05 CSCL 20K

A 336 degrees of freedom slave finite element processing capability to analyze engine structures under severe thermomechanical loading is presented. Description of the theoretical development and demonstration of that element is presented in this volume. Author

N92-19549*# State Univ. of New York, Buffalo. Dept. of Civil Engineering.
LINEAR AND NONLINEAR DYNAMIC ANALYSIS BY BOUNDARY ELEMENT METHOD Ph.D. Thesis, 1986 Final Report
Shahid Ahmad Oct. 1991 268 p Sponsored in part by Pratt and Whitney Aircraft
(Contract NAS3-23697)
(NASA-CR-187228; NAS 1.26:187228) Avail: NTIS HC/MF A12 CSCL 20K

An advanced implementation of the direct boundary element method (BEM) applicable to free-vibration, periodic (steady-state) vibration and linear and nonlinear transient dynamic problems involving two and three-dimensional isotropic solids of arbitrary shape is presented. Interior, exterior, and half-space problems can all be solved by the present formulation. For the free-vibration analysis, a new real variable BEM formulation is presented which solves the free-vibration problem in the form of algebraic equations (formed from the static kernels) and needs only surface discretization. In the area of time-domain transient analysis, the BEM is well suited because it gives an implicit formulation. Although the integral formulations are elegant, because of the complexity of the formulation it has never been implemented in exact form. In the present work, linear and nonlinear time domain transient analysis for three-dimensional solids has been implemented in a general and complete manner. The formulation and implementation of the nonlinear, transient, dynamic analysis presented here is the first ever in the field of boundary element analysis. Almost all the existing formulation of BEM in dynamics use the constant variation of the variables in space and time which is very unrealistic for engineering problems and, in some cases, it leads to unacceptably inaccurate results. In the present work, linear and quadratic isoparametric boundary elements are used for discretization of geometry and functional variations in space. In addition, higher order variations in time are used. These methods of analysis are applicable to piecewise-homogeneous materials, such that not only problems of the layered media and the soil-structure interaction can be analyzed but also a large problem can be solved by the usual sub-structuring technique. The analyses have been incorporated in a versatile, general-purpose computer program. Some numerical problems are solved and, through comparisons with available analytical and numerical results, the stability and high accuracy of these dynamic analysis techniques are established. Author

N92-19551*# Washington Univ., Saint Louis, MO. Inst. of Technology.
HIERARCHIC EXTENSIONS IN THE STATIC AND DYNAMIC ANALYSIS OF ELASTIC BEAMS Ph.D. Thesis, 1990 Final Report, May 1990
Robert A. Watson Sep. 1991 318 p
(Grant NGT-50138)
(NASA-CR-187210; NAS 1.26:187210) Avail: NTIS HC/MF A14 CSCL 20K

Approximate solutions of static and dynamic beam problems by the p-version of the finite element method are investigated. Within a hierarchy of engineering beam idealizations, rigorous formulations of the strain and kinetic energies for straight and circular beam elements are presented. These formulations include rotating coordinate system effects and geometric nonlinearities to allow for the evaluation of vertical axis wind turbines, the motivating problem for this research. Hierarchic finite element spaces, based on extensions of the polynomial orders used to approximate the displacement variables, are constructed. The developed models are implemented into a general purpose computer program for evaluation. Quality control procedures are examined for a diverse set of sample problems. These procedures include estimating discretization errors in energy norm and natural frequencies, performing static and dynamic equilibrium checks, observing convergence for qualities of interest, and comparison with more

exacting theories and experimental data. It is demonstrated that p-extensions produce exponential rates of convergence in the approximation of strain energy and natural frequencies for the class of problems investigated. Author

N92-19664*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTER OPTIMIZATION TECHNIQUES FOR NASA LANGLEY'S CSI EVOLUTIONARY MODEL'S REAL-TIME CONTROL SYSTEM
Kenny B. Elliott, Roberto Ugoletti, and Jeff Sulla (Lockheed Engineering and Sciences Co., Hampton, VA.) Feb. 1992 16 p Proposed for presentation at the 38th International Instrumentation Symposium, Instrument Society of America, Las Vegas, NV, 26-30 Apr. 1992
(NASA-TM-104223; NAS 1.15:104223) Avail: NTIS HC/MF A03 CSCL 20K

The evolution and optimization of a real-time digital control system is presented. The control system is part of a testbed used to perform focused technology research on the interactions of spacecraft platform and instrument controllers with the flexible-body dynamics of the platform and platform appendages. The control system consists of Computer Automated Measurement and Control (CAMAC) standard data acquisition equipment interfaced to a workstation computer. The goal of this work is to optimize the control system's performance to support controls research using controllers with up to 50 states and frame rates above 200 Hz. The original system could support a 16-state controller operating at a rate of 150 Hz. By using simple yet effective software improvements, Input/Output (I/O) latencies and contention problems are reduced or eliminated in the control system. The final configuration can support a 16-state controller operating at 475 Hz. Effectively the control system's performance was increased by a factor of 3. Author

N92-19690# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
KINETICS AND MICROSCOPIC PROCESSES OF LONG TERM FRACTURE IN POLYETHYLENE PIPING MATERIALS Annual Report, 1 Feb. 1990 - 1 Feb. 1991
N. Brown and X. Lu 1 Jul. 1991 147 p
(Contract GRI-5087-260-1468)
(PB92-108844; GRI-91/0147) Avail: NTIS HC/MF A07 CSCL 20K

The report contains 10 published papers entitled: Discontinuous crack growth in polyethylenes under a constant load; Accelerated test for evaluating slow crack growth of polyethylene copolymers in igepal and air; The mechanism of slow crack growth in polyethylene by an environmental stress cracking agent; Dependence of slow crack growth in polyethylene on butyl branch density - morphology and theory; A fatigue test for controlling the quality of polyethylene copolymers; The dependence of slow crack growth in polyethylenes on molecular and morphological structures; Effect of annealing on the morphological and mechanical behavior of an ethylene-hexene copolymer; Slow crack growth in polyethylene - a review; The effect of pressure and contaminants on a butt fusion in a polyethylene gas pipe; and the prediction of long term performance of plastic pipe from fatigue tests. Results are also presented concerning the following topics: The design of a notching machine; Mechanism of fatigue failure in polyethylene copolymer; Effects of molecular weight distribution and crystal thickness distribution on slow crack growth; Blending experiments; Pressure fatigue testing; The international data base on resins; Mechanical properties of crazed material; and The effect of igepal. GRA

N92-19699# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
STRESS ENERGY OF ELASTIC GLOBE IN CURVED SPACE AND A SLIP-OUT FORCE
S. N. Sokolov 1990 6 p
(DE92-608077; IHEP-OTF-90-20; IFVE-OTF-90-20) Avail: NTIS HC/MF A02

The energy of stresses in an elastic globe in the flat space and in curved space is expressed through scalar invariants of the curved space. This energy creates an additional force acting on elastic bodies in a gravitational field. DOE

N92-19714*# State Univ. of New York, Buffalo. Dept. of Civil Engineering.
DEVELOPMENT OF AN INTEGRATED BEM APPROACH FOR HOT FLUID STRUCTURE INTERACTION
Gary F. Dargush, Prasanta K. Banerjee, and Keith A. Honkala Nov. 1991 112 p
(Grant NAG3-712)
(NASA-CR-189052; NAS 1.26:189052) Avail: NTIS HC/MF A06 CSCL 20K

The development of a boundary element formulation for the study of hot fluid-structure interaction in earth-to-orbit engine hot section components is described. The initial primary thrust of the program to date was directed quite naturally toward the examination of fluid flow, since boundary element methods for fluids are at a much less developed state. This required the development of integral formulations for both the solid and fluid, and some preliminary infrastructural enhancements to a boundary element code to permit coupling of the fluid-structure problem. Boundary element formulations are implemented in two dimensions for both the solid and the fluid. The solid is modeled as an uncoupled thermoelastic medium under plane strain conditions, while several formulations are investigated for the fluid. For example, both vorticity and primitive variable approaches are implemented for viscous, incompressible flow, and a compressible version is developed. All of the above boundary element implementations are incorporated in a general purpose two-dimensional code. Thus, problems involving intricate geometry, multiple generic modeling regions, and arbitrary boundary conditions are all supported.
Author

N92-19769# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
OPTIMAL DESIGN OF DAMAGE TOLERANT STRUCTURES
Dag Wiklander 1991 31 p Sponsored by Defence Material Administration and Swedish National Board for Industrial and Technical Development
(FFA-TN-1990-50; ETN-92-90805) Avail: NTIS HC/MF A03

A system for shape optimization of structures was developed. Recent development gave the system a capability to assure the structure of being damage tolerant. The U.S. Air Force damage tolerance requirements for slow crack growth structures as specified in MIL-A-83444 are adopted. Damage tolerant minimum weight designs of structures with feasible stresses, strains, and deflections are found by the system by varying the structural shape. The technique is demonstrated on one test case. ESA

N92-19779*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMGEN-BEM: BOUNDARY ELEMENT MODEL GENERATION FOR COMPOSITE MATERIALS MICROMECHANICAL ANALYSIS
Robert K. Goldberg Mar. 1992 22 p
(NASA-TM-105548; E-6871; NAS 1.15:105548) Avail: NTIS HC/MF A03 CSCL 20K

Composite Model Generation-Boundary Element Method (COMGEN-BEM) is a program developed in PATRAN command language (PCL) which generates boundary element models of continuous fiber composites at the micromechanical (constituent) scale. Based on the entry of a few simple parameters such as fiber volume fraction and fiber diameter, the model geometry and boundary element model are generated. In addition, various mesh densities, material properties, fiber orientation angles, loads, and boundary conditions can be specified. The generated model can then be translated to a format consistent with a boundary element analysis code such as BEST-CMS. Author

N92-19783# Akron Univ., OH. Inst. of Polymer Engineering.
A TRIANGULAR DOUBLE CANTILEVER BEAM TEST FOR MEASURING ADHESIVE OR COHESIVE FRACTURE ENERGY
G. Liu and A. N. Gent Dec. 1991 30 p
(Contract N00014-85-K-0222)
(AD-A243151; TR-29) Avail: NTIS HC/MF A03 CSCL 11/1

A thin layer of adhesive bonded between two stiff elastic plates of uniform thickness and triangular in shape is recommended as a test specimen for measuring cohesive or adhesive strength. It has marked advantages in comparison with current ASTM tests in simplicity of construction and use. Examples are given using silicone rubber layers bonded between steel plates. Double cantilever beam (DCB) tests have been widely used to measure the strength of stiff structural adhesives because the experiments are simple to perform and analyze. GRA

N92-19885# North Carolina State Univ., Raleigh.
ON THE ANALYSIS AND DESIGN OF UNIFORM TRUSS STRUCTURES Ph.D. Thesis
Mark Stephen Lake 1992 134 p
Avail: NTIS HC/MF A07

The behavior and design is examined of uniform truss structures, i.e., trusses which are generated by replication of a characteristic cell uniformly through space. Emphasis is placed on derivation of explicit equations and simple rules. Numerous examples are presented to illustrate the application of newly derived equations to truss design. Two main topics are considered: truss morphology and truss mechanics. Within the topic of morphology, it is concluded that the nature of the anisotropy exhibited by a truss is generally determined by the rotational symmetry present within the truss, regardless of the presence of reflective or inversive symmetry. Also, a condition is derived for kinematic stability in uniform 2-D trusses and it is verified through comparison with finite element analysis. Within the topic of mechanics, procedures are developed for determining and tailoring the equivalent continuum stiffness and strengths of uniform trusses using an existing equivalent continuum theory and a new analytical strength tensor. It is also shown that the discrete arrangement of members within trusses dictates that their equivalent continuum stiffnesses must obey the six Cauchy relations. Thus, the continuum stiffness tensor must be fully symmetric, and 2-D and 3-D isotropic lattices must have equivalent Poisson's ratios of 1/3 and 1/4, respectively. Finally, it is shown that all uniform trusses must have a continuum anisotropic bulk modulus to density ratio equal to the Young's modulus to density ratio of the materials in its members. Author

N92-19887# Stanford Univ., CA. Dept. of Materials Science and Engineering.
MECHANICAL PROPERTIES OF MATERIALS WITH NANOMETER SCALE MICROSTRUCTURES
W. D. Nix Jul. 1991 22 p
(Contract DE-FG03-89ER-45387)
(DE92-004328; DOE/ER-45387/T1) Avail: NTIS HC/MF A03

For the past two years we have been engaged in a program of research on the mechanical properties of a variety of new materials with nanometer scale microstructures. These materials have been developed recently using vapor phase synthesis techniques and are available in the form of compositionally-modulated (multilayered) thin film materials and ultrafine-grained (nanocrystalline) solids. They have interesting microstructures and mechanical properties that may lead to new applications for these materials. In this report we give a brief summary of some of the results we have obtained to date in the course of this research. Other, more detailed, descriptions of some of this work can be found in the papers that we have published. These are listed at the end of this report along with a listing of the oral presentations we have given. We report briefly on our studies of the elastic properties of metallic multilayered thin films. Using indentation and microbeam deflection techniques, we have found that Au/Ni multilayers do not show supermodulus effects, contrary to some previous reports based on bulge test results. However, we have discovered large and significant substrate interaction stresses in these films which depend systematically on the composition modulation wavelength. We believe that these residual stresses may have led to bulge testing errors which in turn led to erroneous reports of supermodulus effects. DOE

N92-19945# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (Germany, F.R.).
NUMERICAL AND EXPERIMENTAL INVESTIGATIONS OF CREEP CRACK GROWTH Final Report [NUMERISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUM KRIECHRISSWACHSTUM. ABSCHLUSSBERICHT]
R. Kienzler and T. Hollstein Feb. 1991 72 p In GERMAN
Sponsored by Wolkswagen-Stiftung
(W-1/91; ETN-92-90630) Avail: NTIS HC/MF A04

Creep crack growth was obtained experimentally for both materials NiCr22Co12Mo at 900C and Nimonic 80A at 650C, and represented more particularly in dependency of an integral stress parameter. The stress parameter was calculated numerically, in correspondance with both definitions, as line integral and as energy release rate. Experimental and numerical results were in good agreement. The experimental determination of the stress parameter is based essentially on an approximation formula, which contains a geometry dependent eta factor that as finite element computation shows, gives very accurate results. For stationary, secondary creep conditions, creep crack growth with the stress parameter can described by a power law. ESA

N92-19983# Sandia National Labs., Albuquerque, NM.
LOCALIZATION AND BIFURCATIONS IN ELASTIC-PLASTIC MATERIALS
M. K Neilsen and H. L. Schreyer (New Mexico Univ., Albuquerque.) 1992 16 p Presented at the American Society of Mechanical Engineers Annual Summer Meeting: Symposium on Recent Advances, Tempe, AZ, 2 Apr. - 1 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-006737; SAND-91-1915C; CONF-920470-1) Avail: NTIS HC/MF A03

When strain-softening, elastic-plastic materials are loaded into the plastic regime, small regions of intense deformation often develop in the material at some point in the loading process. This intense localized deformation limits the formability of materials and will often quickly lead to failure with continued loading. Localized deformation is often associated with satisfaction of the classical discontinuous bifurcation criterion. Here we propose that the loss of strong ellipticity criterion should be used in place of the classical discontinuous bifurcation criterion as a necessary condition for localization. The application of the strong ellipticity criterion implies that a bifurcation mode associated with loss of positive definiteness of the symmetric part of the acoustic tensor must be identified rather than a mode associated with the first zero eigenvalue of the acoustic tensor itself. The eigensystem for the symmetric part of the tangent stiffness tensor is obtained for several different plasticity models. This eigensystem provides information about deformation modes associated with both diffuse and discontinuous bifurcations. Material properties, boundary conditions, and body geometry are all shown to affect the diffuse and localized deformation modes that are generated. Numerous experimental observations of necking and localization in metal specimens subject to various boundary conditions are explained with the proposed approach. DOE

N92-20031*# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
VIBRATION ATTENUATION OF THE NASA LANGLEY EVOLUTIONARY STRUCTURE EXPERIMENT USING H(SUB INFINITY) AND STRUCTURED SINGULAR VALUE (MICRON) ROBUST MULTIVARIABLE CONTROL TECHNIQUES Midyear Report
Gary J. Balas 9 Mar. 1992 55 p
(Grant NAG1-1254)
(NASA-CR-190080; NAS 1.26:190080) Avail: NTIS HC/MF A04 CSCL 20K

The use is studied of active control to attenuate structural vibrations of the NASA Langley Phase Zero Evolutionary Structure

due to external disturbance excitations. H sub infinity and structured singular value (mu) based control techniques are used to analyze and synthesize control laws for the NASA Langley Controls Structures Interaction (CSI) Evolutionary Model (CEM). The CEM structure experiment provides an excellent test bed to address control design issues for large space structures. Specifically, control design for structures with numerous lightly damped, coupled flexible modes, collocated and noncollocated sensors and actuators and stringent performance specifications. The performance objectives are to attenuate the vibration of the structure due to external disturbances, and minimize the actuator control force. The control design problem formulation for the CEM Structure uses a mathematical model developed with finite element techniques. A reduced order state space model for the control design is formulated from the finite element model. It is noted that there are significant variations between the design model and the experimentally derived transfer function data. Author

N92-20045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COLLAPSE ANALYSIS OF A WAFFLE PLATE STRONGBACK FOR SPACE STATION FREEDOM
Frank F. Monasa (Michigan Technological Univ., Houghton.) and Joseph M. Roche Mar. 1992 36 p
(NASA-TM-105412; E-6817; NAS 1.15:105412) Avail: NTIS HC/MF A03 CSCL 20K

The structural integrity was studied of the Integrated Equipment Assembly (IEA) Strongback of the SSF for the launch environment. The strongback structure supports the electrical power system for SSF. To achieve minimum launch mass, it is essential that flight structures are designed as light as possible. A nonlinear structural analysis was conducted to determine the collapse load of the structure and the associated factor of safety against the service loads. A modeling technique is provided for simulating the load conditions and the buckling and post buckling (collapse) load is evaluated of the IEA Strongback structure, using the finite element computer code MARC. Two of four strongback panels were modeled and analyzed. The effects were examined of the following factors on the global behavior of the strongback panels: (1) load simplification and simulation; (2) type of support boundary conditions; and (3) the possibility of weight reduction of the original structure. For this purpose, several models of the two panels of the strongback were considered. The stress level and distribution in the panels for launch condition, the Eigenvalue critical buckling load and/or the collapse load were determined. Author

42 GEOSCIENCES (GENERAL)

N92-19403# Utah Univ., Salt Lake City. Earth Science Lab.
GEOSCIENCES RESEARCH AND DEVELOPMENT
Mar. 1991 117 p
(Contract DE-AC07-85ID-12489)
(DE92-004818; DOE/ID-12489/116; ESL-91001-FR) Avail: NTIS HC/MF A06

This report represents the final report of the University of Utah Research Institute under U.S. Department of Energy Contract No. DE-AC07-85ID-12489. It consists of the abstracts and references of all technical reports generated by UURI under this contract. This report lists the abstracts in DOE report number sequence. The author index of this report will be useful in locating specific references. These reports are all related to earth science and geothermal energy. DOE

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-19223# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundsanwendungen.
PROCEEDINGS OF THE 7TH USER SEMINAR OF THE DLR GERMAN REMOTE SENSING CENTER
Rudolf Winter and Winfried Markwitz 1991 66 p In GERMAN; ENGLISH summary Seminar held in Oberpfaffenhofen, Fed. Republic of Germany, 17-18 Sep. 1990 Original contains color illustrations
(DLR-Mitt-91-09; ISSN-0939-298X; ETN-92-90730) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 34.50 DM

The application potential of data from NOAA, LANDSAT and the ERS-1 satellites was presented, with main emphasis on the processing and application of radar data, and as a preparation for ERS-1. The results of application in forestry in Germany, Alpine regions, and the Soviet Union were given. Investigations in urban areas were reported. Status reports were presented on the funding concept of ecological research, on the International Space Year (ISY 92), and on the processing and filing of ERS-1 data. ESA

N92-19231# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THE APPLICATION OF STATISTICAL ESTIMATION TECHNIQUES TO TERRAIN MODELING M.S. Thesis
Donald P. Duckett, Jr. Dec. 1991 242 p
(AD-A243799; AFIT/GCE/ENG/91D-02) Avail: NTIS HC/MF A11 CSCL 08/2

This thesis researches methods of generating accurate and realistic polygonal terrain models by reducing gridded sampled terrain elevation data such as DMA DTED. The terrain models generated should be applicable for use in flight simulators and other systems. Existing methods of terrain modeling are discussed, and limitations of these systems are presented. The geostatistical estimation technique known as kriging is presented as a method estimating terrain elevations at locations not provided in DMA DTED or other gridded terrain elevation data. Kriging is an optimal interpolation method based on statistical analysis of the data. It also provides a measure of accuracy, the error variance, that allows some control over the accuracy of the resulting terrain model. This estimation method is employed in a terrain modeling system that builds polygonal terrain models at any resolution. This system is described in this thesis, and the results of terrain modeled both by filtering the DMA DTED and by estimating elevations with kriging are presented. The technique as implemented is computationally very expensive and has therefore limited the results of this thesis effort. Also, terrain models that could be produced appeared smoother than their filtered counterparts. However, kriging still shows promise as a method of estimating terrain elevations for terrain models. GRA

N92-19400# National Geodetic Survey, Rockville, MD.
GEOSAT ALTIMETER CROSSOVER DIFFERENCE HANDBOOK
R. E. Cheney, B. C. Douglas, and R. W. Agreen May 1991 37 p
(PB92-105782; NOAA-M-NOS-NGS-6) Avail: NTIS HC/MF A03 CSCL 08B

The first 18 months of the Geosat altimeter sea level data (April 1985 to September 1986) are secret but can be declassified when converted to crossover differences. The authors have constructed a global set of Geosat crossover differences consisting of approximately 44 million values. These data include not just the initial 18-month geodetic mission but also the first year of the subsequent exact repeat mission. This enables computation of

continuous, 2.5-year sea level time series spanning the two missions. In a similar fashion, this will allow the 1985-86 Geosat records to be referenced to future altimeter observations for determination of interdecadal sea level changes. Author

N92-19635# Los Alamos National Lab., NM.
SMALL SATELLITE RADIOMETRIC MEASUREMENT SYSTEM
P. G. Weber 1992 10 p Presented at the AIAA Space Programs and Technologies Conference, Huntsville, AL, 24-27 Mar. 1992
(Contract W-7405-eng-36)
(DE92-004572; LA-UR-91-4169; CONF-920373-1) Avail: NTIS HC/MF A02

A critical need for the U.S. Global Change Research Program is to provide continuous, well-calibrated radiometric data for the earth's radiation budget. This paper describes a new, compact, relatively light-weight, adaptable radiometer which will provide both spectrally integrated measurements and data in selected spectral bands. The radiometer design is suitable for use on small satellites, aircraft, or remotely piloted aircraft (RPA's). An example of the implementation of this radiometer on a small satellite is given. Significant benefits derive from simultaneous measurements of specific narrow (in wavelength) spectral features; such data may be obtained by combining LARI with a compact spectrometer on the same platform. Well-chosen satellite orbits allow one to use data from other satellites (e.g., DMSP) to enhance the data product, or to provide superior coverage of specific locations. DOE

N92-19661# National Geodetic Survey, Rockville, MD.
A REFINED M2 TIDE FROM GEOSAT ALTIMETRY
Carl A. Wagner Jun. 1991 86 p
(PB92-110774; NOAA-TR-NOS-NGS-48) Avail: NTIS HC/MF A05 CSCL 08C

More than 4,000,000 global Geosat altimeter observations, taken mostly in 1986-87, were analyzed for the M2 tide at overlapping points in the satellite's exact repeat mission (ERM). The results are compatible with the Schwiderski (1983) tide model at a level of 5.5 cm (rms discrepancy). The principal features of that model (amphidromes and highs) are unchanged. The altimeter solutions use independent time series for more than 1900 4 degrees by 4 degrees areas of deep oceans. They were calibrated through nine roughly equal and independent subset analyses employing different arcs of the ERM configuration. Results show that 1,652 of the full set M2 solutions have calibrated errors of less than 5 cm. Fairly good agreement exists between the four degree altimeter solutions and and the few (point) tide gage results reported by Schwiderski. Author

N92-19765*# Maine Univ., Orono.
FIELD TESTING OF THERMAL CANOPY MODELS IN A SPRUCE-FIR FOREST Final Technical Report
1990 16 p
(Grant NAG5-1399)
(NASA-CR-190064; NAS 1.26:190064) Avail: NTIS HC/MF A03 CSCL 02F

Recent advances in remote sensing technology allow the use of the thermal infrared region to gain information about vegetative surfaces. Extending existing models to account for thermal radiance transfers within rough forest canopies is of paramount importance. This is so since all processes of interest in the physical climate system and biogeochemical cycles are thermally mediated. Model validation experiments were conducted at a well established boreal forest; northern hardwood forest ecotone research site located in central Maine. Data was collected to allow spatial and temporal validation of thermal models. Emphasis was placed primarily upon enhancing submodels of stomatal behavior, and secondarily upon enhancing boundary layer resistance submodels and accounting for thermal storage in soil and vegetation. Author

N92-19796# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THE APPLICATION OF STATISTICAL KRIGING TO IMPROVE SATELLITE IMAGERY RESOLUTION M.S. Thesis
Donald W. McGee, Jr. Dec. 1991 123 p
(AD-A244014; AFIT/GSO/ENS/91D-13) Avail: NTIS HC/MF A06 CSCL 08/2

Imagery analysts are always looking for improved methods of analyzing digital satellite imagery. The resolution of satellite imagery can be improved by enlarging the images since the result will be a higher degree of discernable detail. Currently, nearest-neighbor, bilinear interpolation, and cubic convolution techniques are used for this purpose. The nearest-neighbor technique produces block-like images. The latter two methods produce sharp imagery, but the original information contained in the pixel values is changed in the process of convolving the image. These techniques cannot, therefore, be considered true representations of the original image. Kriging is a statistical technique which can be applied to enlarging satellite imagery. Specifically, it is a method of best linear unbiased prediction of spatial data. One of the benefits of kriging is that it is an exact interpolator: the original pixel values will not be modified in the resulting kriged images. This thesis develops the application of universal punctual kriging to the analysis of digital satellite imagery. Current convolution techniques and kriging are used to produce enlarged images and comparisons are made. Images are also sub-sampled and enlarged back to the original size using convolution and statistical methods. This allows the products of cubic convolution and kriging to be subtracted from the original image. This procedure provides an additional quantitative comparison of kriging and cubic convolution. Results indicate that kriging performs as well as or better than cubic convolution when used to enlarge images. GRA

N92-19840# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS AND INTEGRATION OF GEOLOGICAL, TM/LANDSAT 5 AND GEOPHYSICAL DATA FOR GEOLOGICAL MAPPING AND MINERAL PROSPECTING IN THE IRAJAI AREA (NORTHEAST BRAZIL) Thesis
Sebastiao Milton Pin daSilva Apr. 1991 170 p In PORTUGUESE; ENGLISH summary Original contains color illustrations Topographic map as supplement
(INPE-5263-TDI/441) Avail: NTIS HC/MF A08

Geological, Thematic Mapper (TM)/LANDSAT-5 and geophysical data were analyzed and integrated to assess their contribution to the improvement of methodologies for geological mapping and mineral prospecting in semiarid terrain, such as the Brazilian Northeast region. The following data were analyzed: geological ground-based; airborne gamma-ray spectrometric; aeromagnetic total field; and principal component images derived from digital processing of TM/LANDSAT-5 data. The geophysical data stored in magnetic tapes and contour lines were converted from vector to raster format and displayed as black and white or color images and shaded relief. Those outputs were registered with geometrically corrected LANDSAT images. The information content of both data sets were correlated and assessed by overlaying the geophysical data derived images with digitally processed TM/LANDSAT images. The images were submitted to the following digital enhancement techniques before being manually and visually analyzed: contrast stretch, standardized principal component analysis (PCA) and red-green-blue (RGB) color composites. This type of images data manipulation provided more geological information than those derived from conventional methods for geological mapping. They gave a better assessment of existing geological-geophysical correlations, anomalies and lithological units previously documented in the area. More geological information derived from this study was added to the knowledge of the studied area, by locating one more granitic body and a shallowly buried basic intrusion; redefining the contact between the metavolcanic-sedimentary rocks of the Irajai Complex and gneisses and migmatitic rocks of the Gneissic-Migmatitic Complex and mapping lithological subunits in this complex in the investigated area. Author

N92-20023# Geological Survey, Morgantown, WV. Water Resources Div.
RELATIONS BETWEEN WARM SPRINGS AND GEOLOGY DELINEATED BY SIDE-LOOKING AIRBORNE-RADAR IMAGERY IN EASTERN WEST VIRGINIA
P. Lessing, W. A. Hobba, S. L. Dean, and B. R. Kulander 1991 70 p Prepared in cooperation with Geological and Economic Survey, Morgantown, WV
(PB92-107515; USGS/WRI-88-4096) Avail: NTIS HC/MF A04 CSCL 08H

The utility of side-looking airborne radar (SLAR) imagery for mapping lineaments and geologic structure in the vicinity of warm springs in eastern West Virginia is documented. The information was used in conjunction with geologic maps and water-quality analyses to define the geologic setting and hydrologic regime in the vicinity of the springs. GRA

N92-20036*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LIGHTNING IMAGING SENSOR (LIS) FOR THE EARTH OBSERVING SYSTEM
Hugh J. Christian, Richard J. Blakeslee, and Steven J. Goodman Feb. 1992 42 p Original contains color illustrations
(NASA-TM-4350; M-680; NAS 1.15:4350) Avail: NTIS HC/MF A03; 4 functional color pages CSCL 04B

Not only are scientific objectives and instrument characteristics given of a calibrated optical LIS for the EOS but also for the Tropical Rainfall Measuring Mission (TRMM) which was designed to acquire and study the distribution and variability of total lightning on a global basis. The LIS can be traced to a lightning mapper sensor planned for flight on the GOES meteorological satellites. The LIS consists of a staring imager optimized to detect and locate lightning. The LIS will detect and locate lightning with storm scale resolution (i.e., 5 to 10 km) over a large region of the Earth's surface along the orbital track of the satellite, mark the time of occurrence of the lightning, and measure the radiant energy. The LIS will have a nearly uniform 90 pct. detection efficiency within the area viewed by the sensor, and will detect intracloud and cloud-to-ground discharges during day and night conditions. Also, the LIS will monitor individual storms and storm systems long enough to obtain a measure of the lightning flashing rate when they are within the field of view of the LIS. The LIS attributes include low cost, low weight and power, low data rate, and important science. The LIS will study the hydrological cycle, general circulation and sea surface temperature variations, along with examinations of the electrical coupling of thunderstorms with the ionosphere and magnetosphere, and observations and modeling of the global electric circuit. Author

N92-19314*# Purdue Univ., West Lafayette, IN. Dept. of Agricultural Engineering.
MULTISPECTRAL IMAGE PROCESSING FOR PLANTS
Gaines E. Miles *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 236-260 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 02C

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-19071# L'Garde, Inc., Tustin, CA.
INFLATABLE TORUS SOLAR ARRAY TECHNOLOGY PROGRAM, PHASE 1 Final Report, Mar. 1990 - Oct. 1991
Billy Derbis, Koorosh Guidanean, Pat Malone, Art Palisoc, and Gordon Veal 15 Oct. 1991 208 p
(Contract F29601-90-C-0006)
(AD-A243996; LTR-91-V-022-Phase-1) Avail: NTIS HC/MF A10 CSCL 10/2

This Phase 1 of the Inflatable Torus Solar Array Technology (ITSAT) Program demonstrated the feasibility of an inflatably deployed solar array. During the program, several array conceptual designs for various orbits and power levels were prepared. A flexible amorphous silicon solar array was fabricated and mounted in a lightweight inflatably deployed rigidizable structure. This prototype unit was successfully packaged and deployed. Author (GRA)

N92-19445# Solid-State Fuel Cells, Inc., Columbia, MD.
CHARACTERIZATION AND DEVELOPMENT OF A NEW CERAMIC ELECTROLYTE FOR FUEL CELL APPLICATIONS
Jun. 1991 73 p
(Contract DE-AC21-87MC-24164)
(DE91-002092; DOE/MC-24164/3012) Avail: NTIS HC/MF A04

This work consisted of research directed toward characterization and development of new solid electrolyte materials that are potentially superior to other solid electrolyte materials currently under development (such as yttria-stabilized zirconia). The solid electrolyte technology described herein is based on new ceramic materials generally described as bismuth oxide doped with niobium or yttrium oxides that were exclusively licensed to Solid-State Fuel Cells, Inc. by CeramPhysics, Inc. The technology is also based on further material, cell, and stack technology concepts and manufacturing methods that were earlier reduced to practice by Solid State Fuel Cells, Inc., and which are, therefore, proprietary to the Company. In this report, a presentation of the overall program background is provided in Section 2.0. This includes a technical discussion of the technology in the context of the current state of the art. The task work description for the applicable portion of Phase 1 is presented in Section 3.0. Specifically, Phase 1-A comprises the following elements: electrolyte materials development; testing of electrolyte stability under a reducing environment; development of cell electrodes; test fixtures design and facility erection; and preliminary coupon cell tests. DOE

N92-19566 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
MAXWELL DEMON, DISPATCHER, AND HEAT ENGINES [DEMON MAKSVELLA, DISPETCHER I TEPLOVYE MASHINY]
V. S. Mashkevich and S. V. Mashkevich 1990 41 p In RUSSIAN
Copyright Avail: Issuing Activity

A quantum dynamic solution is given for the problem of the Maxwell demon. It is shown that the possibility exists for the system (called a dispatcher) to fulfill the functions of the demon at the cost of an increase in its entropy. A general definition is given of the heat engine and a model of the quantum heat engine is examined. The dispatcher plays a vital role in the functioning of this engine. Transl. by L.K.H.

N92-19619# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY
W. R. Bottenberg (Astropower, Inc., Newark, DE.) Nov. 1991 18 p
(Contract DE-AC02-83CH-10093)
(DE91-015031; NREL/TP-214-4568) Avail: NTIS HC/MF A03

This report describes the development of a process for preparing thin crystalline silicon on a low-cut substrate. Three cells derived from this process are described; two incorporate light trapping and back surface passivation. Wafer, solar cell, and module fabrication processes and improvements of those processes by using the wafer forming process developed by AstroPower also are described. Solar cells fabricated from AstroPower's Silicon-Film wafers use less material, eliminate ingot sawing, and have the potential to achieve high production rates. Problems in fabrication processes are identified and their solutions are explained. AstroPower proposes a 3-year plan (phase 2) to develop a high-performance, low-cost solar cell used for terrestrial power applications. DOE

N92-19620# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY
S. Albright (Photon Energy, Inc., El Paso, TX.) Nov. 1991 13 p
(Contract DE-AC02-83CH-10093)
(DE91-015032; NREL/TP-214-4569) Avail: NTIS HC/MF A03

This report summarizes the analysis of photovoltaic module manufacturing done by Photon Energy, Inc. Photon Energy's four-stage expansion plan for photovoltaic module manufacturing is explained. Explored and studied were the following: current capabilities in manufacturing and process development, potential for increasing production and reducing manufacturing costs, problems likely to impede increased production and reduced manufacturing costs, and costs and other requirements involved in overcoming problems in manufacturing technology. DOE

N92-19624# Midwest Research Inst., Golden, CO.
COST EFFECTIVE MANUFACTURING OF THE SEA 10X CONCENTRATOR ARRAY
N. Kaminar, J. McEntee, and D. Curchod Nov. 1991 100 p Prepared in cooperation with Solar Engineering Applications Corp., San Jose, CA
(Contract DE-AC02-83CH-10093)
(DE92-001151; NREL/TP-214-4479) Avail: NTIS HC/MF A05

This report describes a low-cost, mass-producible 10X concentrator system that has been claimed to produce electricity at $0.04/kWh. It details changes in manufacturing techniques that could produce a concentrator system at a selling price of $0.71/W (A simple design and a minimum number of parts and manufacturing steps reduced production costs). Present production techniques, changes to improve these techniques, impediments to changes, and solutions to the impediments are described. This 10X concentrator system uses available components and manufacturing processes and one-sun solar cells in conjunction with inexpensive plastic lenses to generate about eight times the amount of electricity normally produced by these cells. DOE

N92-19625# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
RESEARCH ON ADVANCED PHOTOVOLTAIC MANUFACTURING TECHNOLOGY
T. Jester and C. Eberspacher (Siemens Solar Industries, Camarillo, CA.) Nov. 1991 46 p
(Contract DE-AC02-83CH-10093)
(DE92-001153; NREL/TP-214-4481) Avail: NTIS HC/MF A03

This report outlines opportunities for significantly advancing the scale and economy of high-volume manufacturing of high-efficiency photovoltaic (PV) modules. We propose to pursue a concurrent effort to advance existing crystalline silicon module manufacturing technology and to implement thin film CuInSe2 (CIS) module manufacturing. This combination of commercial-scale manufacturing of high-efficiency crystalline silicon modules and of pilot-scale manufacturing of low-cost thin film CIS technology will support continued, rapid growth of the US PV industry. DOE

N92-19629# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
DEVELOPMENT OF A FIXED ABRASIVE SLICING TECHNIQUE (FAST) FOR REDUCING THE COST OF PHOTOVOLTAIC WAFERS
F. Schmid (Crystal Systems, Inc., Salem, MA.) Dec. 1991 58 p
(Contract DE-AC02-83CH-10093)
(DE92-001165; NREL/TP-214-4485) Avail: NTIS HC/MF A04

This report examines a wafer slicing technique developed by Crystal Systems, Inc. that reduces the cost of photovoltaic wafers. This fixed, abrasive slicing technique (FAST) uses a multiwire bladepack and a diamond-plated wirepack; water is the coolant. FAST is in the prototype production stage and reduces expendable material costs while retaining the advantages of a multiwire slurry technique. The cost analysis revealed that costs can be decreased by making more cuts per bladepack and slicing more wafers per linear inch. Researchers studied the degradation of bladepacks and increased wirepack life. DOE

N92-19633# Midwest Research Inst., Golden, CO.
THE NREL TEETERING HUB ROTOR CODE: FINAL RESULTS AND CONCLUSIONS
A. D. Wright and C. P. Butterfield Dec. 1991 10 p Presented at the American Society of Mechanical Engineers (ASME) Energy Sources Technology Conference and Exhibition, Houston, TX, 26-30 Jan. 1992
(Contract DE-AC02-83CH-10093)
(DE92-001187; NREL/TP-257-4517; CONF-920122-4) Avail: NTIS HC/MF A02

Accurately predicting wind turbine blade loads and response is important for the proper design of wind turbines. The need to accurately predict both deterministic and stochastic blade loads is now widely recognized. Previous rotor code development and validation efforts at NREL have concentrated on prediction of deterministic and stochastic blade loads for rigid hub rotors. During the past year, this effort was expanded for predicting blade and shaft loads for two-bladed teetering hub rotors. The NREL (formerly SERI) Teetering Rotor Analysis Program (STRAP), a derivative of the Force and Loads Analysis Program (FLAP), can include the effects of rotor undersling, delta-3, and the effects of a concentrated hub mass. The degrees of freedom include rotor teeter and symmetric and asymmetric rotor flap modes. A time-dependent, prescribed yaw motion can also be input to the code. Loads due to turbulent wind inputs are also calculated. In this paper, final code modifications, final comparisons of load predictions to test data, and finally, the direction for new code development activities at NREL are described. DOE

N92-19640# Japanese Society of Energy Resources, Osaka.
PROCEEDINGS OF THE 10TH STUDY PRESENTATION MEETING OF JAPAN SOCIETY OF ENERGY AND RESOURCES
1991 314 p Meeting held in Tokyo, Japan, 24-25 Apr. 1991
(DE92-729087; CONF-9104313) Avail: NTIS HC/MF A14

Concerning solar/natural energy, reports are made on a design of wind turbine arrays, hydrogen production by solar thermal conversion, demonstration tests with the interconnected system, etc. About the combustion, discussions are made on efficiency and pollution abatement measures. Besides solid electrolyte and internal-heat-reforming type molten carbonate fuel cells, test runs of phosphoric acid fuel cells for the district heat supply/on-site use are conducted. Furthermore, studies on the ocean thermal energy conversion and the wave power generation are taken up. The global energy system is also proposed which combines the photovoltaic power generation, hydrogen production and methanol fuel synthesis using flue gas CO2 transported by tanker in the desert for the global warming prevention/resource recycling. Reports on energy conservation using energy storage and heat pumps are made. Application of electric power to superconductivity technology is reported on. As for the energy system, district cooling and heating, alternative energy, cogeneration, etc. are introduced, and then many examples of energy conservation and non-pollution are presented. DOE

N92-19658# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY PROGRAM
S. Hogan (Spire Corp., Bedford, MA.) Nov. 1991 36 p
(Contract DE-AC02-83CH-10093)
(DE91-015026; NREL/TP-214-4476) Avail: NTIS HC/MF A03

The work performed in this contract was focused on two areas: an economic analysis of present manufacturing methods and the conceptualization of advanced equipment. The economic analysis was built on our experience with tabbing and connecting thick cells. This experience was used to generate the cost analysis that clearly points to the improvements in yield and throughput to make PV manufacturing more cost effective. DOE

N92-19659# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
LOW-COST MANUFACTURING OF THE POINT FOCUS CONCENTRATING MODULE AND ITS KEY COMPONENT, THE FRESNEL LENS
T. Saifee and A. Konnerth, III (Solar Kinetics, Inc., Dallas, TX.) Nov. 1991 98 p
(Contract DE-AC02-83CH-10093)
(DE91-015028; NREL/TP-214-4477) Avail: NTIS HC/MF A05

Solar Kinetics, Inc. (SKI) has been developing point-focus concentrating PV modules since 1986. SKI is currently in position to manufacture between 200 to 600 kilowatts annually of the current design by a combination of manual and semi-automated methods. This report reviews the current status of module manufacture and specifies the required approach to achieve a high-volume manufacturing capability and low cost. The approach taken will include process development concurrent with module design for automated manufacturing. The current effort reviews the major manufacturing costs and identifies components and processes whose improvements would produce the greatest effect on manufacturability and cost reduction. The Fresnel lens is one such key component. Investigating specific alternative manufacturing methods and sources has substantially reduced the lens costs and has exceeded the DOE cost-reduction goals. DOE

N92-19843# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY (PVMaT) IMPROVEMENTS FOR ENTECH'S CONCENTRATOR MODULE
M. J. ONeill, A. J. McDanal, J. L. Perry, M. C. Jackson, and R. R. Walters Nov. 1991 34 p Prepared in cooperation with ENTECH, Inc., Dallas-Fort Worth Airport, TX
(Contract DE-AC02-83CH-10093)
(DE92-001170; NREL/TP-214-4486) Avail: NTIS HC/MF A03

This final technical report documents ENTECH's Phase 1 contract with Photovoltaic Manufacturing Technology (PVMaT) project. Under this project we prepared a detailed description of our current manufacturing process for making our unique linear Fresnel lens photovoltaic concentrator modules. In addition, we prepared a detailed description of an improved manufacturing process, which will simultaneously increase module production rates, enhance module quality, and substantially reduce module costs. We also identified potential problems in implementing the new manufacturing process, and we proposed solutions to these anticipated problems. Before discussing the key results of our program, however, we present a brief description of our unique photovoltaic technology. The key conclusion of our PVMAT Phase 1 study is that our module technology, without further breakthroughs, can realistically meet the near-term DOE goal of 12 cents/kWh levelized electricity cost, provided that we successfully implement the new manufacturing process at a production volume of at least 10 megawatts per year. The key recommendation from our Phase 1 study is to continue our PVMaT project into Phase 2A, which is directed toward the actual manufacturing technology development required for our new module production process. DOE

N92-19872# Sandia National Labs., Albuquerque, NM.
PERSPECTIVES OF WIND ENERGY UTILIZATION IN THE FEDERAL REPUBLIC OF GERMANY
Jens-Peter Molly, T. Schott, W.-J. Schmidt-Kuester, and Werner Tegen (IEAL Energie Consult G.m.b.H., Bonn, Germany, F.R.) Foerderesill Schaft Windenergie e.V. Sep. 1991 19 p Transl. into ENGLISH of German document
(Contract DE-AC04-76DP-00789)
(DE92-002790; ALS/TR-91/025; ETDE-MF-9911274) Avail: NTIS HC/MF A03

This paper contains only the table of contents and summary hypotheses from a full paper that assessed current and future prospects of wind power in Germany. The potential for power generation is forecasted along with cost estimations. The benefits to the environment, as compared with other energy sources, are discussed. The use of hybrid systems with diesel engines in remote installations, and the market for wind turbines are among other topics discussed. DOE

N92-19888# Midwest Research Inst., Golden, CO.
IMPROVED TECHNIQUES FOR MANUFACTURING THE ALPHA SOLARCO CONCENTRATING PHOTOVOLTAIC SYSTEM
E. Schmidt Nov. 1991 31 p
(Contract DE-AC02-83CH-10093)
(DE91-015029; NREL/TP-214-4498) Avail: NTIS HC/MF A03

This report describes the overall procedure involved in the manufacture of photovoltaic cells and modules; identifies and describes potential cell and module manufacturing processes that can lead to improved performance, reduced manufacturing costs and significantly increased production; notes the long-range potential benefits of these improvements; identifies and describes any problems that may impede the achievement of the long-range benefits; and identifies and describes the approaches for solving the identified implementation problems, including time and cost estimates. DOE

N92-19890# Midwest Research Inst., Golden, CO.
ROLE OF POLYCRYSTALLINITY IN CdTe AND CuInSe2 PHOTOVOLTAIC CELLS
J. R. Sites (Colorado State Univ., Fort Collins.) 1991 23 p
(Contract DE-AC02-83CH-10093)
(DE92-001168; NREL/TP-214-4468) Avail: NTIS HC/MF A03

The polycrystalline nature of thin-film CdTe and CuInSe2 solar cells continues to be a major factor in several individual losses that limit overall cell efficiency. This report describes progress in the quantitative separation of these losses, including both measurement and analysis procedures. It also applies these techniques to several individual cells to help document the overall progress with CdTe and CuInSe2 cells. Notably, CdTe cells from Photon Energy have reduced window photocurrent losses to 1 mA/Cm(exp 2); those from the University of South Florida have achieved a maximum power voltage of 693 mV; and CuInSe2 cells from International Solar Electric Technology have shown a hole density as high as 7 x 10(exp 16) cm(exp -3), implying a significant reduction in compensation. DOE

N92-19891# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
POLYCRYSTALLINE THIN-FILM SOLAR CELLS AND MODULES
H. S. Ullal, J. L. Stone, K. Zweibel, T. Surek, and R. L. Mitchell Dec. 1991 7 p Presented at the 6th International Photovoltaic Science and Engineering Conference, New Delhi, India, 10-14 Feb. 1992
(Contract DE-AC02-83CH-10093)
(DE92-001196; NREL/TP-214-4610; CONF-920227-3) Avail: NTIS HC/MF A02

This paper describes the recent technological advances in polycrystalline thin-film solar cells and modules. Three thin film materials, namely, cadmium telluride (CdTe), copper indium diselenide (CuInSe2, CIS) and silicon films (Si-films) have made substantial technical progress, both in device and module performance. Early stability results for modules tested outdoors by various groups worldwide are also encouraging. The major global players actively involved in the development of the these technologies are discussed. Technical issues related to these materials are elucidated. Three 20-kW polycrystalline thin-film demonstration photovoltaic (PV) systems are expected to be installed in Davis, CA in 1992 as part of the Photovoltaics for Utility-Scale Applications (PVUSA) project. This is a joint project between the U.S. Department of Energy (DOE), Pacific Gas and Electric (PG&E), Electric Power Research Institute (EPRI), California Energy Commission (CEC), and a utility consortium. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-19038# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
LOMPOC VALLEY DIFFUSION EXPERIMENT ANALYSIS: MT. IRON COMPARISON AND TWO ZONE CONVECTIVE SCALING MODEL
C. E. Skupniewicz, R. F. Kamada, and S. A. Drake 2 Jan. 1992 115 p
(AD-A244382; NPS-PH-92-004) Avail: NTIS HC/MF A06 CSCL 04/2

LVDE (Lompoc Valley Diffusion Experiment) was conducted Aug. 1989 to assess the potential risk of gaseous releases from the Hypergolic Stockpile and Storage Facility at Vandenberg AFB. Results of the LVDE are compared to the predictive equations of the Mt. Iron Diffusion Tests, conducted at Vandenberg in the 1960's. The Mt. Iron equation parameterizes diffusion with on-base meteorological tower input data. Regression techniques similar to those of Mt. Iron are used in this comparison, resulting in LVDE equations which use the same meteorological data as input. Instantaneous and time averaged centerline concentrations, in both flat and complex terrain are analyzed. For all cases LVDE concentrations are shown to decrease with range less rapidly than the Mt. Iron equation predicts. We suggest that this bias is due to gravitational and/or scavenging losses of the tracer material used in Mt. Iron. A 'two-zone' convective scaling equation is developed which diffuses the plume differently in cloud covered and clear sky portions of the domain. The method is shown to be superior to homogeneous convective scaling equations, and comparable to a statistical approach based on the plume measurements. While the method works for maximum concentration predictions, it fails for plume width and crosswind integrated concentration for X greater than 6. GRA

N92-19121*# National Aeronautics and Space Administration, Washington, DC.
THE ATMOSPHERIC EFFECTS OF STRATOSPHERIC AIRCRAFT: A FIRST PROGRAM REPORT
Michael J. Prather, Howard L. Wesoky, Richard C. Miake-Lye, Anne R. Douglass, Richard P. Turco, Donald J. Wuebbles, Malcolm K. W. Ko, and Arthur L. Schmeltekopf (National Oceanic and Atmospheric Administration, Washington, DC.) Jan. 1992 227 p
(NASA-RP-1272; NAS 1.61:1272) Avail: NTIS HC/MF A11 CSCL 13B

Studies have indicated that, with sufficient technology development, high speed civil transport aircraft could be economically competitive with long haul subsonic aircraft. However, uncertainty about atmospheric pollution, along with community noise and sonic boom, continues to be a major concern; and this is addressed in the planned 6 yr HSRP begun in 1990. Building on NASA's research in atmospheric science and emissions reduction, the AESA studies particularly emphasizing stratospheric ozone effects. Because it will not be possible to directly measure the impact of an HSCT aircraft fleet on the atmosphere, the only means of assessment will be prediction. The process of establishing credibility for the predicted effects will likely be complex and involve continued model development and testing against climatological patterns. Lab simulation of heterogeneous chemistry and other effects will continue to be used to improve the current models. For individual titles, see N92-19122 through N92-19127.

N92-19122*# Aerodyne Research, Inc., Billerica, MA.
HIGH-SPEED CIVIL TRANSPORT AIRCRAFT EMISSIONS
Richard C. Miake-Lye, J. A. Matulaitis, F. H. Krause, Willard J. Dodds, Martin Albers, J. Hourmouziadis, K. L. Hasel, R. P. Lohmann, C. Stander, and John H. Gerstle (Boeing Commercial Airplane Co., Seattle, WA.) et al *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 13-31 Prepared in cooperation with Douglas Aircraft Co., Inc., Long Beach, CA (For primary document see N92-19121 10-45)
Avail: NTIS HC/MF A11 CSCL 13B

Estimates are given for the emissions from a proposed high speed civil transport (HSCT). This advanced technology supersonic aircraft would fly in the lower stratosphere at a speed of roughly Mach 1.6 to 3.2 (470 to 950 m/sec or 920 to 1850 knots). Because it would fly in the stratosphere at an altitude in the range of 15 to 23 km commensurate with its design speed, its exhaust effluents could perturb the chemical balance in the upper atmosphere. The first step in determining the nature and magnitude of any chemical changes in the atmosphere resulting from these proposed aircraft is to identify and quantify the chemically important species they emit. Relevant earlier work is summarized, dating back to the Climatic Impact Assessment Program of the early 1970s and current propulsion research efforts. Estimates are provided of the chemical composition of an HSCT's exhaust, and these emission indices are presented. Other aircraft emissions that are not due to combustion processes are also summarized; these emissions are found to be much smaller than the exhaust emissions. Future advances in propulsion technology, in experimental measurement techniques, and in understanding upper atmospheric chemistry may affect these estimates of the amounts of trace exhaust species or their relative importance. Author

N92-19123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NATURAL CYCLES, GASES
Anne R. Douglass, Charles H. Jackman, R. B. Rood, A. C. Aikin, R. S. Stolarski, M. P. McCormick, and David W. Fahey (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 33-61 (For primary document see N92-19121 10-45)
Avail: NTIS HC/MF A11 CSCL 13B

The major gaseous components of the exhaust of stratospheric aircraft are expected to be the products of combustion (CO2 and H2O), odd nitrogen (NO, NO2 HNO3), and products indicating combustion inefficiencies (CO and total unburned hydrocarbons). The species distributions are produced by a balance of photochemical and transport processes. A necessary element in evaluating the impact of aircraft exhaust on the lower stratospheric composition is to place the aircraft emissions in perspective within the natural cycles of stratospheric species. Following are a description of mass transport in the lower stratosphere and a discussion of the natural behavior of the major gaseous components of the stratospheric aircraft exhaust. Author

N92-19124*# California Univ., Los Angeles.
UPPER-ATMOSPHERE AEROSOLS: PROPERTIES AND NATURAL CYCLES
Richard P. Turco *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 63-91 (For primary document see N92-19121 10-45)
(Grants NAGw-2183; NAG1-1126)
Avail: NTIS HC/MF A11 CSCL 13B

The middle atmosphere is rich in its variety of particulate matter, which ranges from meteorite debris, to sulfate aerosols, to polar stratospheric ice clouds. Volcanic eruptions strongly perturb the stratospheric sulfate (Junge) layer. High-altitude 'noctilucent' ice clouds condense at the summer mesopause. The properties of these particles, including their composition, sizes, and geographical distribution, are discussed, and their global effects, including chemical, radiative, and climatic roles, are reviewed. Polar stratospheric clouds (PSCs) are composed of water and nitric acid in the form of micron-sized ice crystals. These particles catalyze reactions of chlorine compounds that 'activate' otherwise inert chlorine reservoirs, leading to severe ozone depletions in the southern polar stratosphere during austral spring. PSCs also modify the composition of the polar stratosphere through complex physiocochemical processes, including dehydration and denitrification, and the conversion of reactive nitrogen oxides into nitric acid. If water vapor and nitric acid concentrations are

enhanced by high-altitude aircraft activity, the frequency, geographical range, and duration of PSCs might increase accordingly, thus enhancing the destruction of the ozone layer (which would be naturally limited in geographical extent by the same factors that confine the ozone hole to high latitudes in winter). The stratospheric sulfate aerosol layer reflects solar radiation and increases the planetary albedo, thereby cooling the surface and possibly altering the climate. Major volcanic eruptions, which increase the sulfate aerosol burden by a factor of 100 or more, may cause significant global climate anomalies. Sulfate aerosols might also be capable of activating stratospheric chlorine reservoirs on a global scale (unlike PCSs, which represent a localized polar winter phenomenon), although existing evidence suggests relatively minor perturbations in chlorine chemistry. Nevertheless, if atmospheric concentrations of chlorine (associated with anthropogenic use of chlorofluorocarbons) continue to increase by a factor of two or more in future decades, aircraft emissions of sulfur dioxide and water vapor may take on greater significance.
Author

N92-19125*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
DESIGNING A METHODOLOGY FOR FUTURE AIR TRAVEL SCENARIOS
Donald J. Wuebbles, Steven L. Baughcum, John H. Gerstle, Jae Edmonds, Douglas E. Kinnison, Nick Krull, Munir Metwally, Alan Mortlock (McDonnell-Douglas Corp., Long Beach, CA.), and Michael J. Prather *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 93-113 (For primary document see N92-19121 10-45)
Avail: NTIS HC/MF A11 CSCL 13B

The growing demand on air travel throughout the world has prompted several proposals for the development of commercial aircraft capable of transporting a large number of passengers at supersonic speeds. Emissions from a projected fleet of such aircraft, referred to as high-speed civil transports (HSCT's), are being studied because of their possible effects on the chemistry and physics of the global atmosphere, in particular, on stratospheric ozone. At the same time, there is growing concern about the effects on ozone from the emissions of current (primarily subsonic) aircraft emissions. Evaluating the potential atmospheric impact of aircraft emissions from HSCT's requires a scientifically sound understanding of where the aircraft fly and under what conditions the aircraft effluents are injected into the atmosphere. A preliminary set of emissions scenarios are presented. These scenarios will be used to understand the sensitivity of environment effects to a range of fleet operations, flight conditions, and aircraft specifications. The baseline specifications for the scenarios are provided: the criteria to be used for developing the scenarios are defined, the required data base for initiating the development of the scenarios is established, and the state of the art for those scenarios that have already been developed is discussed. An important aspect of the assessment will be the evaluation of realistic projections of emissions as a function of both geographical distribution and altitude from an economically viable commercial HSCT fleet. With an assumed introduction date of around the year 2005, it is anticipated that there will be no HSCT aircraft in the global fleet at that time. However, projections show that, by 2015, the HSCT fleet could reach significant size. We assume these projections of HSCT and subsonic fleets for about 2015 can the be used as input to global atmospheric chemistry models to evaluate the impact of the HSCT fleets, relative to an all-subsonic future fleet. The methodology, procedures, and recommendations for the development of future HSCT and the subsonic fleet scenarios used for this evaluation are discussed. Author

N92-19126*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
OZONE RESPONSE TO AIRCRAFT EMISSIONS: SENSITIVITY STUDIES WITH TWO-DIMENSIONAL MODELS
Malcolm K. W. Ko, Debra Weisenstein, Charles H. Jackman, Anne R. Douglass, K. Bureske, Donald J. Weubbles, Douglas E. Kinnison, G. Brasseur, J. Pyle, and Anna Jones (Cambridge Univ., England) *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 115-157 Prepared in cooperation with NASA. Langley Research Center; Edinburgh Univ.; and Oslo Univ. (For primary document see N92-19121 10-45)
Avail: NTIS HC/MF A11 CSCL 13B

Our first intercomparison/assessment of the effects of a proposed high-speed civil transport (HSCT) fleet on the stratosphere is presented. These model calculations should be considered more as sensitivity studies, primarily designed to serve the following purposes: (1) to allow for intercomparison of model predictions; (2) to focus on the range of fleet operations and engine specifications giving minimal environmental impact; and (3) to provide the basis for future assessment studies. The basic scenarios were chosen to be as realistic as possible, using the information available on anticipated developments in technology. They are not to be interpreted as a commitment or goal for environmental acceptability. Author

N92-19127*# National Oceanic and Atmospheric Administration, Boulder, CO.
LOWER STRATOSPHERIC MEASUREMENT ISSUES WORKSHOP REPORT
Arthur L. Schmeltekopf *In* NASA, Washington, The Atmospheric Effects of Stratospheric Aircraft: A First Program Report Jan. 1992 p 159-186 (For primary document see N92-19121 10-45)
Avail: NTIS HC/MF A11 CSCL 13B

The Lower Stratospheric Measurement Issues workshop was held on 17-19 Oct. 1990. The 3-day workshop was sponsored by the Atmospheric Effects of Stratospheric Aircraft (AESA) component of the High Speed Research Program (HSRP). Its purpose was to provide a scientific forum for addressing specific issues regarding chemistry and transport in the lower stratosphere, for which measurements are essential to an assessment of the environmental impact of a projected fleet of high speed civil transports (HSCTs). The objective of the workshop was to obtain vigorous and critical review of the following topics: (1) atmospheric measurements needed for the assessment; (2) present capability for making those measurements; and (3) areas in instrumentation or platform development essential to making the measurements.
Author

N92-19226# Tilburg Univ. (Netherlands). Dept. of Economics.
TECHNIQUES FOR SENSITIVITY ANALYSIS OF SIMULATION MODELS: A CASE STUDY OF THE CO2 GREENHOUSE EFFECT
Jack P. C. Kleijnen, Greet vanHam, and Jan Rotmans (National Inst. of Public Health, Bilthoven, Netherlands) Jun. 1990 27 p (FEW-448; ETN-92-90888) Avail: NTIS HC/MF A03

Sensitivity analysis is needed for validation, what-if analysis, and optimization of complicated simulation models. One set of techniques for sensitivity analysis are least squares curve fitting, regression analysis, and statistical designs such as factorial designs. These techniques are applied to several modules of a large integrated assessment model for the greenhouse effect. The regression models turn out to be valid approximations to the simulation models. Some estimated effects are quite surprising for the simulation users. ESA

N92-19271# Westinghouse Hanford Co., Richland, WA.
HANFORD ENVIRONMENTAL INFORMATION SYSTEM (HEIS) USER'S MANUAL
Oct. 1991 833 p
(Contract DE-AC06-87RL-10930)
(DE92-003953; WHC-EP-0372-Vol-1-Rev-1) Avail: NTIS HC/MF A99

The Hanford Environmental Information System (HEIS) is a consolidated set of automated resources that effectively manage the data gathered during environmental monitoring and restoration of the Hanford Site. The HEIS includes an integrated database that provides consistent and current data to all users and promotes sharing of data by the entire user community. Data stored in the

HEIS are collected under several regulatory programs. Currently these include the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA); the Resource Conservation and Recovery Act of 1976 (RCRA); and the Ground-Water Environmental Surveillance Project, managed by the Pacific Northwest Laboratory. The HEIS is an information system with an inclusive database. The manual, the HEIS User's Manual, describes the facilities available to the scientist, engineer, or manager who uses the system for environmental monitoring, assessment, and restoration planning; and to the regulator who is responsible for reviewing Hanford Site operations against regulatory requirements and guidelines. DOE

N92-19300 Royal Netherlands Meteorological Inst., De Bilt. Afdel. Fysische Meteorologie.

SEASONAL VARIATION AND TREND IN THE CHEMICAL COMPOSITION OF PRECIPITATION AT LELYSTAD (NETHERLANDS) (1983-1985) [SEIZOENVERLOOP EN TREND IN DE CHEMISCHE SAMENSTELLING VAN DE NEERSLAG TE LELYSTAD]

T. A. Buishand and J. H. Baard (Netherlands Energy Research Foundation, Petten.) 1991 36 p In DUTCH; ENGLISH summary

(KNMI-TR-133; ISSN-0169-1708; ETN-92-91034) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

The chemical composition of precipitation at Lelystad was investigated using cluster analysis. The composition was sampled on a daily basis using wet only collectors. Statistical analysis was performed on the monthly concentrations and deposition. One group of chemicals is mainly due to precipitation of marine origin, the other group is mainly due to continental air masses. The temporal variation was described by fitting multiple regression models. No linear trend was found. The effect of the precipitation quantity on the monthly concentrations and deposits is statisticlally significant in most cases. The most striking fact is that the monthly values within the separate groups have a much weaker sinusoidal annual cycle than those of all precipitation samples. The systematic annual cycle of the wet only samples of Lalystad differs markedly from that of the monthly bulk samples in the national network. Despite the fact that two distinct groups can be formed, the temporal variation of concentrations within these groups remains large. ESA

N92-19375# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Geophysics.

A STUDY OF THE OPERATIONAL PRINCIPLES OF THE GOMOS INSTRUMENT FOR GLOBAL OZONE MONITORING BY THE OCCULTATION OF STARS Ph.D. Thesis

Seppo O. Korpela Helsinki, Finland Finnish Meteorological Inst. 26 Feb. 1991 175 p Sponsored by Technology Development Center; Suomer Akatemia; and Technical Research Centre of Finland

(Geophy-Publ-22; ISBN-951-697-338-8; ISSN-0782-6087; ETN-92-90822) Avail: NTIS HC/MF A08

Studies made during the proposal of the global ozone monitoring by the occultation of stars (GOMOS) instrument are considered. The instrument was proposed to ESA for the Polar Platform Program as an announcement of opportunity instrument in the Earth Observation Program. The original instrument was proposed to ESA in 1988, and it was selected for the Phase A study in 1989. The photometric accuracy and the Earth coverage of the method are studied, showing that the stellar occultation method has well-proven capabilities to make accurate measurements of long-term trends of global ozone. Photometric evaluation shows that the accuracy of 1 percent can be achieved on the night side of the Earth with stars down to visual magnitude 3. On the day side, the signal-to-noise ratio is reduced by the atmospheric background light, but still, measurements with brighter stars can be made (magnitude less than 2). The Earth coverage simulations show that about 30 occultations on one orbit period (101 min) can be measured, and the measurement points are distributed evenly around the globe. The poles are sensitive to the availability of stars in a certain direction, and they are covered with varying success. The effect of the instrument parameters and limitations were also studied in the coverage simulations, showing that the design has well-optimized instrument parameters. ESA

N92-19520# National Defence Research Establishment, Umea (Sweden).

ANALYSIS OF VOLATILE ORGANIC SUBSTANCES EMITTED FROM PVC FLOORINGS

Lars Rittfeldt Sep. 1991 39 p In SWEDISH; ENGLISH summary

(FOA-C-40288-4.5; ISSN-0347-2124; ETN-92-90808) Avail: NTIS HC/MF A03; National Defence Research Establishment, Umeaa, Sweden, HC 100 Swedish crowns

The emission of VOC (volatile organic compounds) from PVC (polyvinyl chloride) floorings was sampled on Tenax adsorbent tubes by means of a glass shade covering a defined area of the floor. The Tenax tubes were thermally desorbed and analyzed with a gas chromatographic mass spectrometric system. Samples of PVC floorings, underlayed with different materials at three levels of humidity (RH 50, 80, and 90) were stored in a room at a temperature of 23 C and a humidity of RH 45. The emission of VOC from the samples was analyzed four times during a period of eight months. For most of the samples, the emission declined from about 160 micro g/sq m h (one week) to about 80 micro g/sq m h (three months). Two samples, with floor tile glued in the most humid (RH 90) concrete (no leveling compound), had an increasing emission after about one month. The increase was mainly made up of 2-ethyl hexanol that was formed in the hydrolysis of the esters present in the glue. When using a leveling compound having a lower pH than concrete, the degradation of materials in humid floors did not occur. ESA

N92-19543# Geological Survey, Columbus, OH. Water Resources Div.

COMBINED-NETWORK APPROACH FOR COMPILATION, EVALUATION, AND ANALYSIS OF PRECIPITATION-CHEMISTRY DATA FOR THE UPPER OHIO RIVER VALLEY AND LOWER GREAT LAKES REGION, 1976-1985

D. N. Myers 1991 218 p

(PB92-106186; USGS/WRI-91-4003) Avail: NTIS HC/MF A10 CSCL 13B

The purpose is to characterize the areal, seasonal, and year-to-year changes in the chemical composition of precipitation with reference to nine major ions and two physical properties. The major inorganic-chemical constituents and related physical properties and characteristics of precipitation are pH, hydrogen ion, sulfate, nitrate, chloride, ammonium, sodium, potassium, magnesium, and amount of precipitation. A detailed analysis of the areal and temperal patterns of precipitation chemistry in the upper Ohio River Valley and lower Great Lakes region was undertaken by use of a combination of data. The data, which span the period 1976-85, were selected from several independent precipitation-chemistry data collection networks. Precipitation chemistry is characterized for Ohio, Indiana, Kentucky, lower Michigan, New York, Pennsylvania, West Virginia, and southern Ontario, Canada. Author

N92-19547# Radian Corp., Research Triangle Park, NC.

EMISSION INVENTORY REQUIREMENTS FOR CARBON MONOXIDE STATE IMPLEMENTATION PLANS, 1991

Mar. 1991 77 p

(Contract EPA-68-D00125)

(PB92-112150; EPA/450/4-91/011) Avail: NTIS HC/MF A05 CSCL 13B

Described here are the emission inventory requirements related to the preparation and submission of carbon monoxide State Implementation Plans (SIPs) for those states required to revise plans after November 15, 1990. Discussed here are emission inventory requirements related to geographic area of coverage, point source cutoff size specifications, sources to be included,

data reporting formats, documentation requirements, quality of the data base, years to be addressed, and the schedule for inventory submission. Author

N92-19548# Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
THE SUPER ESP: ULTIMATE ELECTROSTATIC PRECIPITATION Report, Jan. 1990 - Sep. 1991
Norman Plaks 1991 14 p Presented at the 9th Symposium on Particulate Control, Williamsburg, VA, 15-18 Oct. 1991
(PB92-113125; EPA/600/D-91/245) Avail: NTIS HC/MF A03 CSCL 13B

Discussed here is SUPER ESP, a new electrostatic precipitator (ESP) concept, enabling high collection efficiencies with considerably smaller collection areas than has previously been possible. The new concept allows a major reduction in ESP size by using an alternating sequence of prechargers and short collector sections. The length of the collection section in each precharger/collector pair (module) dominates the optimization. The size reduction is greater for ESPs operating with high resistivity particulate matter than with low resistivity particulate matter. The relationship in number of modules, collector section size, and overall ESP collection is presented and discussed. Comparisons are given of ESP size for both conventional and SUPER ESP technology operating with either high or low resistivity particulate matter. Because of the size reduction, the cost of the SUPER ESP is projected to be lower than the cost of a conventional ESP of comparable efficiency. The discussion is based on an ESP model, ESPVI 4.0. Author

N92-19550 Washington Univ., Saint Louis, MO.
NUMERICAL MODELING OF CLOUD CHEMISTRY AND ACID DEPOSITION ASSOCIATED WITH THE INTERACTIONS OF TWO RAINBANDS AND SOME COMPARISONS WITH OBSERVATIONS Ph.D. Thesis
Mary Christine Barth 1991 198 p
Avail: Univ. Microfilms Order No. DA9131606

A diagnostic modeling study is described of the chemistry of two cold-frontal rainbands that were observed on the mid-Atlantic coast of the United States. A modified version of the Hegg et al (1989) cloud microphysics-chemistry model is used to simulate a narrow cold-frontal rainband and a wide cold-frontal rainband. The contribution of the pathways for oxidizing aqueous sulfur dioxide is examined for each rainband. In the narrow cold-frontal rainband, iron-catalyzed aerobic oxidation contributed the most to the oxidation of aqueous sulfur dioxide, but oxidation by ozone and hydrogen peroxide also contributed significantly. In the wide cold-frontal rainband, oxidation by hydrogen peroxide was the greatest contributor towards the rear of the band, and iron-catalyzed aerobic oxidation and oxidation by ozone contributed the most at the leading edge of the band. Surface sulfate deposition rates from the wide cold-frontal rainband predicted by the model were up to five times greater than those derived from measurements, most likely due to high input concentrations of sulfur dioxide and aerosol sulfate. Surface nitrate deposition rates from the wide cold-frontal rainband predicted by the model were up to eight times smaller than those derived from measurements, most likely due to low input concentrations of aqueous nitrate precursors. When the two rainbands were allowed to interact, by having the narrow cold-frontal rainband process the air that entered the wide cold-frontal rainband that followed it, the total sulfate deposition from both the narrow and wide cold-frontal rainbands decreased by only 2 percent. The total nitrate deposition remained essentially unchanged when the rainbands were allowed to interact. These differences are small due to the small amount of aerosol scavenging at upper levels of the wide cold-frontal rainband, where differences in the input aerosol concentrations were found. The effects on the sulfate and nitrate deposition of the initial concentrations of their precursors in the clear air ahead of each rainband is examined. For most cases that are modeled, the sulfate and nitrate depositions responded approximately linearly to variations in the concentrations of their precursors. Dissert. Abstr.

N92-19634# Oak Ridge National Lab., TN.
APPROACHES TO SCALING UP PHYSIOLOGICAL RESPONSES OF FORESTS TO AIR POLLUTANTS
R. J. Luxmoore 1991 12 p Presented at the Specialty Conference on Tropospheric Ozone and the Environment, Atlanta, GA, 5-7 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004448; CONF-911180-2) Avail: NTIS HC/MF A03

The regional distribution of a forest specie encompasses favorable and unfavorable environments. Modeling of physiological responses of trees to air pollutants in such a range of environments requires a consistent level of modeling detail for both above- and below-ground processes. A source-sink framework is recommended as a suitable physiological basis for modeling the feed forward and feedback relationships between photosynthesis and carbon utilization of forest stands distributed over a heterogeneous region. The variability of soil and plant properties over a region can be represented with frequency distributions of model input variables and these can be efficiently propagated through a simulator with a Monte Carlo procedure called Latin hypercube sampling. The outputs from this method (e.g., forest production, site index) are in the form of frequency distributions that can be compared statistically for alternative air pollutant exposure scenarios. These outputs from physiological modeling can also be used as input distributions in longer time-step models of forest succession and forest management. Selection of suitable variables to propagate from one scale to another is a critical challenge in simulation of long-term forest responses to air pollutants over regional spatial scales. An index of storage carbohydrate is suggested as one important variable for transfer from physiological modeling to forest succession modeling for scaling up purposes. DOE

N92-19637# Pacific Northwest Lab., Richland, WA.
A FACILITY FOR USING CLUSTER RESEARCH TO STUDY ENVIRONMENTAL PROBLEMS
Nov. 1991 58 p Presented at the A Facility for Using Cluster Research to Study Environmental Problems Workshop, Seattle, WA, 16-19 Jun. 1990
(Contract DE-AC06-76RL-01830)
(DE92-004759; PNL-SA-19788; CONF-9006372) Avail: NTIS HC/MF A04

This report begins by describing the general application of cluster based research to environmental chemistry and the development of a Cluster Structure and Dynamics Research Facility (CSDRF). Next, four important areas of cluster research are described in more detail, including how they can impact environmental problems. These are: surface-supported clusters, water and contaminant interactions, time-resolved dynamic studies in clusters, and cluster structures and reactions. These facilities and equipment required for each area of research are then presented. The appendices contain workshop agenda and a listing of the researchers who participated in the workshop discussions that led to this report. DOE

N92-19657# Department of Energy, New York, NY.
ENVIRONMENTAL MEASUREMENTS LABORATORY ANNUAL REPORT, 1990
N. A. Chieco, ed. and J. Hoppen, ed. Nov. 1991 111 p
(DE92-004856; EML-542) Avail: NTIS HC/MF A06

This report summarizes the activities of the Environmental Measurements Laboratory (EML) for the calendar year 1990 and it serves as an annual report to the Director of the Office of Energy Research (OER), the Associate Director and staff of the Office of Health and Environmental Research (OHER), the manager and staff of the Field Office--Chicago, and our colleagues. The progress and accomplishments of the year are emphasized rather than future plans or expectations. The technical summaries are grouped according to the following six general program areas: environmental radiation and radioactivity; radiation transport and dosimetry; environmental radon, thoron, and related aerosols; atmospheric and surface pollutant studies related to global climate change; ecological and subsurface pollutant research; and metrology, consultation, and emergency response. DOE

N92-19676# Environmental Protection Agency, Research Triangle Park, NC. Quality Assurance Management Staff.
HARMONIZATION OF QA PROCEDURES FOR ENVIRONMENTAL DATA OPERATIONS: DEVELOPMENT OF A NATIONAL CONSENSUS STANDARD FOR QUALITY ASSURANCE FOR ENVIRONMENTAL PROGRAMS
G. L. Johnson, D. W. Wolfe, and S. M. Blacker Oct. 1991 21 p Presented at the Proceedings of the 19th Annual Energy Division Conference of the American Society for Quality Control, Oct. 1991 Prepared in cooperation with Bechtel Corp., San Francisco, CA; and MAC Technical Services, Germantown, MD
(PB91-240523; EPA/600/D-91/221) Avail: NTIS HC/MF A03 CSCL 13B

Decisions on where and how to clean up Federally-owned facilities contaminated by mixtures of hazardous chemical and radioactive wastes requires that quality environmental data be obtained. The Federal Government is currently using several different standards or sets of requirements for establishing the quality assurance and quality control (QA/QC) procedures associated with environmental data operations for these sites. These standards defined the criteria for the QA activities and documentation required, the content and format of the documentation, and who was responsible for implementation. Shortcomings in these standards of requirements led in 1989 to efforts by several public and private sector groups to 'harmonize' the multiple sets of standards and requirements into a single set. These efforts are being conducted under the auspices of the American Society for Quality Control (ASQC) and involve participation by the Environmental Protection Agency (EPA), Department of Energy (DOE), Department of Defense (DOD), Nuclear Regulatory Commission (NRC), and others in the contractor and regulated communities. The progress toward establishing a national consensus standard for QA for environmental programs through the ASQC standard-setting process is described. Author

N92-19704# Environmental Protection Agency, Ann Arbor, MI. Office of Mobile Sources.
NONROAD ENGINE AND VEHICLE EMISSION STUDY: REPORT AND APPENDIXES Draft Report
Oct. 1991 457 p
(PB92-104462) Avail: NTIS HC/MF A20 CSCL 13B

The study quantifies the contributions of emissions from nonroad engines and vehicles to the air quality problem. EPA considered over 80 different types of nonroad equipment in this analysis. The equipment types include: lawn and garden equipment, airport service, recreational, recreational marine, light commercial, industrial, construction, agricultural, logging, and commercial marine vessels. Aircraft and locomotives were not included. Emission inventories, (detailed listings of amounts of pollutants to account for emissions from various sources) were developed and analyzed for categories of nonroad equipment. The study does not attempt to make a determination of the significance of emissions from nonroad sources. Appendixes which provide background information are presented. Author

N92-19705# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
ACID-MODES 1988: SUMMARY DATA REPORT. AIRCRAFT MEASUREMENTS OF SELECTED POLLUTION SPECIES
R. L. Gunter and J. F. Boatman Aug. 1991 52 p
(PB92-107929; NOAA-TM-ERL-ARL-189) Avail: NTIS HC/MF A04 CSCL 13B

Cloud water samples were taken and chemical, meteorological, and aerosol measurements were made with the NOAA King Air C-90 aircraft during August and September 1988 in northeastern Pennsylvania in support of the Acid Model Operational-Diagnostic Evaluation Study (Acid-MODES). Two other aircraft were involved: Battelle Laboratory's G-1 and the West German Hawker-Siddeley (HS) 125. The objectives of Acid-MODES, the instrumentation used, and the data obtained with the NOAA King Air, and the King Air's data processing, data quality, and data availability are listed. Author

N92-19722# Oak Ridge National Lab., TN.
ABSORPTION CHILLERS: PART OF THE SOLUTION
Anthony J. Occhionero, Patricia J. Hughes, and Edward A. Reid, Jr. (Columbia Gas Distribution Co., Columbus, OH.) 1991 10 p Presented at the International Chlorofluorocarbon (CFC) and Halon Alternatives Conference, Baltimore, MD, 3-5 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-002331; CONF-911256-2) Avail: NTIS HC/MF A02

Acid rain, ozone depletion, global warming, and implementation economics are considered as they relate to the advisability of expanding the application of absorption chillers. Introductory and background information are provided to put the discussion in the proper context. Then all four issues are discussed separately as they relate to absorption chillers. Acid rain and ozone depletion concerns, and implementation economics, are found to support the expanded use of absorption chillers. The global warming concern is found to be more of a gray area, but the areas of benefit correspond well with the conditions of greatest economic advantage. All things considered, absorption chillers are believed to be part of the environmental and economic solution. It is further believed that integrated resource planning (IRP) processes that consider electric and gas technologies on an equal footing would come to the same conclusion for many regions of the United States. DOE

N92-19791# Lawrence Livermore National Lab., CA.
THE COMPUTER HARDWARE ADVANCED MATHEMATICS AND MODEL PHYSICS (CHAMMP) CLIMATE MODELING PROGRAM
D. C. Bader, M. C. MacCracken, and R. C. Malone (Los Alamos National Lab., NM.) Nov. 1991 5 p Presented at the 3rd Symposium for Global Change Studies, Atlanta, GA, 5-10 Jan. 1991
(Contract W-7405-eng-48)
(DE92-004671; UCRL-JC-108853; CONF-9101125-1) Avail: NTIS HC/MF A01

Improved methods for predicting the world's future climate and the potential climate change caused by anthropogenic activities are needed to guide domestic and international energy policy formulation. Current general circulation models (GCM's) of the atmosphere and ocean that form the basis for climate projections are useful, but lack: treatment of interactions among the atmosphere, ocean, cryosphere, and land surface; the adequate representation of key processes such as radiative transfer and cloud development; and relatively coarse spatial resolution. The demands that must be met by future climate models have been established in the development of the U.S. Global Change Research Program (USGCRP) and their importance is evidenced by the designation of climate modeling and prediction as one of the four high priority integrating themes of the program. The U.S. DOE CHAMMP Program is a multiyear climate modeling research program designed to bring the computational power of emerging computer systems to further climate research. This requires true multidisciplinary collaboration among climate scientists, applied mathematicians, and computer scientists. Since the ultimate goal is to provide better scientific prediction, research is also directed toward estimating the limits of climate predictability and the uncertainty of model results. Through interactions with other programs of the USGCRP and US High Performance Computing and Communications Program (HPCC), it will contribute to more definitive projections of climate change to aid in the formulation of national and international energy policy. DOE

N92-19800# California Univ., Berkeley. Lawrence Berkeley Lab.
PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON REDUCING CARBON DIOXIDE EMISSIONS FROM THE DEVELOPING WORLD: ASSESSMENT OF BENEFITS, COSTS AND BARRIERS
J. Sathaye, ed. and N. Goldman, ed. Jun. 1991 50 p Proceedings held in Berkeley, CA, 4-6 Oct. 1990
(Contract DE-AC03-76SF-00098)

(DE92-004171; LBL-30850; CONF-9010449-Summ) Avail: NTIS HC/MF A03

The International Workshop on Reducing Carbon Dioxide Emissions from the Developing World was the second workshop held as part of a project being conducted by the International Energy Studies Group of Lawrence Berkeley Laboratory, in collaboration with experts from leading institutions across the developing world. The goal of the project is to analyze long-range energy consumption in developing countries and its potential contribution to global climate change. The U.S. Environmental Protection Agency (EPA) is supporting this work, the results of which already have made a key contribution to the technical analysis being used as the basis for discussion by the Energy and Industry Sub-group of the Intergovernmental Panel on Climate Change (IPCC). The main purpose of this workshop was two-fold: (1) to discuss the feasibility of implementing the efficiency improvements and fuel switching measures incorporated into the long-term energy scenarios created for 17 developing countries; and (2) to examine the costs and benefits of reducing energy-related carbon dioxide emissions generated by developing countries. DOE

N92-19826# Computer Sciences Corp., Research Triangle Park, NC.

REGIONAL OZONE MODELING FOR NORTHEAST TRANSPORT (ROMNET) Final Report

N. C. Possiel, L. B. Milich, B. R. Goodrich, E. L. Meyer, and K. L. Schere Jun. 1991 335 p Prepared in cooperation with Alliance Technologies Corp., Chapel Hill, NC

(Contracts EPA-68-01-7176; EPA-68-D9-0173)

(PB92-108786; EPA/450/4-91/002A) Avail: NTIS HC/MF A15 CSCL 13B

The Regional Ozone Modeling for Northeast Transport (ROMNET) Project was initiated by the U.S. EPA, State, and local air pollution agencies in the Northeast to address the problem of regional transport in developing effective and equitable control programs to attain the ozone National Ambient Air Quality Standard in the region. The specific goals of ROMNET are: (1) to evaluate the relative effectiveness of regional controls on ozone levels in the Northeast; (2) to provide quantitative estimates of ozone and precursor levels transported between urban areas following application of control measures; and (3) to provide procedures and guidance for incorporating ozone and precursor transport in future State Implementation development. Author

N92-19850# Environmental Protection Agency, Research Triangle Park, NC. Office of Air Quality Planning and Standards.

PROCEDURES FOR THE PREPARATION OF EMISSION INVENTORIES FOR CARBON MONOXIDE AND PRECURSORS OF OZONE. VOLUME 1: GENERAL GUIDANCE FOR STATIONARY SOURCES

May 1991 234 p

(PB92-112168; EPA/450/4-91/016) Avail: NTIS HC/MF A11 CSCL 13B

Described here are procedures for preparing a county wide inventory of volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO) for stationary sources. This is an update to the original study (PB89-152409), published in 1988. Author

N92-19902# Technical Resources, Inc., Rockville, MD. Risk Assessment and Regulatory Toxicology Group.

METHODOLOGY FOR ASSESSING ENVIRONMENTAL RELEASES OF AND EXPOSURE TO MUNICIPAL SOLID WASTE COMBUSTOR RESIDUALS Final Report

Abe Mittelman, Issac Diwan, Ron Brown, Lou Cofone, Matthew Lorber (Environmental Protection Agency, Washington, DC.), and Joseph Greenblott Apr. 1991 148 p

(Contract EPA-68-02-4199)

(PB92-109149; OHEA-E-374; EPA/600/8-91/031) Avail: NTIS HC/MF A07 CSCL 13B

The purpose is to provide users with a methodology to assess the potential exposure to municipal solid waste (MSW) residuals by: (1) summarizing existing information on MSW combustor design, types, and location of MSW facilities nationally; beneficial uses of ash; characteristics of ash; and contaminant concentrations of ash; (2) summarizing the management of MSW ash to identify points of environmental release from generation to disposal in a landfill; (3) providing methodologies to quantify these releases; and (4) directing the reader to other documents which detail fate and transport models, and exposure and risk algorithms. An example is given of the methodologies applied to an organic contaminant, TCDD, and an inorganic contaminant, cadmium, both common in MSW combustor residuals. Author

N92-19908# Oklahoma Univ., Norman. Dept. of Botany and Microbiology.

ANAEROBIC BIOTRANSFORMATION OF CONTAMINANTS IN THE SUBSURFACE

J. M. Suflita and G. W. Sewell Feb. 1991 11 p Sponsored in part by Robert S. Kerr Environmental Research Lab., Ada, OK

(Grant EPA-R-812808)

(PB91-240549; EPA/600/M-90/024) Avail: NTIS HC/MF A03 CSCL 13B

Anaerobic conditions predominate in contaminated aquifers and are common in noncontaminated areas. Comparatively little is known about degradative processes and nutrient cycling under anaerobic conditions. However, it is apparent these processes are fundamentally different and more complex than comparable aerobic processes. Research in this area is critical to the understanding of the fate of contaminants in the subsurface environment and for the design and operation of efficient and effective treatment technologies. The objective of the research brief is to report the current status of research directed toward defining anaerobic microbial metabolic processes which occur in the subsurface environment. Author

N92-19913# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.

STATUS AND NEEDS FOR TOXIC EMISSION INVENTORIES FOR REGIONAL DISPERSION AND DEPOSITION MODELING

W. G. Benjey 1991 15 p Presented at the EPA/AWMA International Specialty Conference on Emission Inventory Issues in the 1990s, Durham, NC, 9-12 Sep. 1991 Prepared in cooperation with NOAA, Research Triangle Park, NC

(PB92-110394; EPA/600/D-91/242) Avail: NTIS HC/MF A03 CSCL 13B

Title 3 of the Clean Air Act Amendments of 1990 established several new study and regulatory requirements for toxic air pollutants that make dispersion and deposition modeling and the associated toxic emission inventories necessary. There are currently no comprehensive regional emission inventories compiled with the purpose of regional dispersion modeling of toxic emissions. Limited emission inventories have or are being compiled although not necessarily for the purpose of modeling. There are useful data bases from which information can be extracted to construct interim regional toxic emission inventories. In the long term, basic information on toxics and improved inventory methodologies are needed to create inventories sufficient to drive sophisticated models. These needs may be summarized as: (1) improved toxic speciation and emission factors and application techniques; (2) improved knowledge of the atmospheric chemistry of toxic emissions; and (3) intergovernmental coordination in compiling emission inventories nmd in conducting research on toxic chemicals. Author

N92-19914# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.

PRODUCTION OF CARBON MONOXIDE BY THE HOMOGENEOUS NOx-INDUCED PHOTOOXIDATION OF VOLATILE ORGANIC COMPOUNDS IN THE TROPOSPHERE

A. P. Altshuller 1991 30 p Submitted for publication

(PB92-110576; EPA/600/J-91/254) Avail: NTIS HC/MF A03 CSCL 13B

The reaction mechanisms of products, along with their rates of reaction with hydroxyl radicals and their rates of photolysis, were used to obtain carbon monoxide (CO), yields from the products of the homogeneous atmospheric photooxidation from emissions of hydrocarbons and other volatile organic compounds (VOCs). Seasonally averaged CO yields are estimated for a number of types of VOCs. The annual production of CO is estimated for the contiguous U.S. from combustion sources of CO and from the atmospheric photooxidation of anthropogenic and biogenic emissions of VOCs. Limitations on estimates of CO yields and of CO production from various heterogeneous processes are discussed. Author

N92-19943# New York Univ., New York. Dept. of Applied Science.

THE ROLE OF CLOUDS AND OCEANS IN GLOBAL GREENHOUSE WARMING

M. I. Hoffert Jan. 1992 15 p

(Contracts DE-FG02-90ER-61014; W-7405-eng-48)

(DE92-007018; DOE/ER-61014/2) Avail: NTIS HC/MF A03

The overall objectives of this project has been to exploit empirical data from atmospheric measurements, satellite data and paleoclimatic reconstructions to derive the role of cloud radiative forcing on the historical global temperature record and on projections of global warming from greenhouse gases during the coming decades. Our work has involved data analysis and modelling tasks involving both atmospheric radiation and ocean modelling. A major accomplishment this past year has been the derivation of global climate sensitivity and the cloud radiative feedback from a new analysis of paleoclimatic data. A detailed discussion of this work and it implications is given as the appendix to this Progress Report. Some additional research planning considerations are discussed below. DOE

N92-19959# Florida State Univ., Tallahassee. Dept. of Oceanography.

ROLE OF ACID RAIN IN ATMOSPHERIC DEPOSITION Final Report

J. W. Winchester 31 Dec. 1990 45 p Sponsored in part by NOAA, Washington; and Florida State Dept. of Environmental Regulation, Tallahassee

(Contract NA89AA-D-CZ-228)

(PB91-241471) Avail: NTIS HC/MF A03 CSCL 13B

The potential importance was assessed of atmospheric nitrate deposition for a north Florida estuary. A comparison, based on statistical analysis of fluxes of ten dissolved constituents of rain and river waters, was carried out for the watershed of the Apalachicola River, using weekly rain water chemical data from the National Acid Deposition Program for five sites within the watershed area, monitored from 1978 to 1984 until late 1989. Similar statistical analysis was performed on monitoring data for the Sopchoppy and Ochlockonee Rivers of north Florida. Atmospheric deposition to the watershed appears to be sufficient to account for essentially all the dissolved nitrate and ammonium and total organic nitrogen flow in the three rivers. However, after deposition most of the nitrate may be transformed to other chemical forms during the flow of the rivers toward their estuaries. In an additional statistical analysis of rain water monitoring data from the eight state southeastern USA region, it was found that both meteorological conditions and transport from pollution sources appear to control deposition fluxes of nitrate and sulfate acid air pollutants. Author

N92-19963# Computer Sciences Corp., Research Triangle Park, NC.

REGIONAL OZONE MODELING FOR NORTHEAST TRANSPORT (ROMNET). APPENDICES Final Report

N. C. Possiel, L. B. Milich, B. R. Goodrich, E. L. Meyer, and K. L. Schere Jun. 1991 344 p Prepared in cooperation with Alliance Technologies Corp., Chapel Hill, NC

(Contracts EPA-68-01-7176; EPA-68-D9-0173)

(PB92-108794; EPA/450/4-91/002B) Avail: NTIS HC/MF A15 CSCL 13B

The Regional Ozone Modeling for Northeast Transport (ROMNET) Project was initiated by the U.S. EPA and state and local air pollution agencies in the northeast to address the problem of regional transport in developing effective and equitable control programs to attain the ozone National Ambient Air Quality Standard in the region. The specific goals of ROMNET are: (1) to evaluate the relative effectiveness of regional controls on ozone levels in the northeast; (2) to provide quantitative estimates of ozone and precursor levels transported between urban areas following application of control measures; and (3) to provide procedures and guidance for incorporating ozone and precursor transport in future state implementation development. ROMNET included the application of the EPA Regional Oxidant Model for a number of regional emissions control strategies. These strategies were designed to address five major issues, which are listed and briefly discussed. Author

N92-19971# Research Triangle Inst., Research Triangle Park, NC.

SUMMARY OF THE 1991 EPA/AWMA INTERNATIONAL SYMPOSIUM: MEASUREMENT OF TOXIC AND RELATED AIR POLLUTANTS

R. K. M. Jayanty and B. W. Gay 1991 16 p Symposium held in Durham, NC, 6-10 May 1991 Sponsored in part by EPA, Research Triangle Park, NC

(PB92-110386; EPA/600/D-91/241) Avail: NTIS HC/MF A03 CSCL 13B

A joint conference co-sponsored by the Atmospheric Research and Exposure Assessment Lab (AREAL) of the EPA and the Air and Waste Management Association was held. The technical program consisted of 220 presentations, held in 25 sessions, on recent advances in the measurement and monitoring of toxic and related pollutants found in ambient and source atmospheres. Covering a wide range of measurement topics and supported by 78 exhibitors of instrumentation and consulting services, the symposium was attended by almost a thousand professionals from the U.S. and other countries. Some areas of discussion include: Atlanta 1990 ozone precursor study; atmospheric chemistry and fate of toxic pollutants; measurement of particulate and acidic aerosols; mountain top cloud water chemistry; asbestos exposure assessment; mobile sources emission characterization; product emissions measurement in chambers; nicotine in environmental tobacco smoke; and US/USSR joint air pollution studies. Author

N92-19979# Los Alamos National Lab., NM.

SIMULATIONS OF GREENHOUSE TRACE GASES USING THE LOS ALAMOS CHEMICAL TRACER MODEL

C. Y. J. Kao, E. Morz, and X. Tie (Scripps Institution of Oceanography, San Diego, CA.) Nov. 1991 26 p Presented at the Conference on Global Climate Change: Its Mitigation Through Improved Production and Utilization of Energy, Los Alamos, NM, 21-24 Oct. 1991

(Contract W-7405-eng-36)

(DE92-005055; LA-UR-91-4049; CONF-9110127-2) Avail: NTIS HC/MF A03

Through three-dimensional global model studies on atmospheric composition and transport, we are improving our quantitative understanding of the origins and behavior of trace gases that affect Earth's radiative energy balance and climate. We will focus, in this paper, on the simulations of three individual trace gases including CFC-11, methyl chloroform, and methane. We first used our chemical tracer model to study the global distribution and trend of chemically inert CFC-11 observed by the Atmospheric Lifetime Experiment. The results show that the model has the ability to reproduce the time-series of the observations. The purpose of this CFC-11 simulation was to test the transport of the model. We then used the model to introduce methyl chloroform into the atmosphere according to the known emission patterns and iteratively varied OH fields so that the observed concentrations of methyl chloroform from the observations could be well simulated. The rationale behind this approach is that the reaction with OH is the dominant sink for metyl chloroform and the transport of the model has been tested in the previous CFC-11

study. Finally, using the inferred OH distributions, we conducted a steady-state simulation to reproduce the current methane distribution. The general agreement between the modeled and observed methane surface concentrations has laid a foundation for the simulation of the transient increase of methane. DOE

N92-19988# Oak Ridge National Lab., TN.
AMBIENT AIR MONITORING FOR MERCURY AROUND AN INDUSTRIAL COMPLEX
R. R. Turner and M. A. Bogle 1991 19 p Presented at the Managing Hazardous Air Pollutants: State of the Art, Washington, DC, 4-6 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007315; CONF-911139-1) Avail: NTIS HC/MF A03

Public and scientific interest in mercury in the environment has experienced an upsurge in the past few years, due in part to disclosures that fish in certain waters, which have apparently received no direct industrial discharges, were contaminated with mercury. Atmospheric releases of mercury from fossil fuel energy generators, waste incinerators and other industrial sources are suspected to be contributing to this problem. Such releases can be evaluated in a variety of ways, including stack sampling, material balance studies, soil/vegetation sampling and ambient air monitoring. Ambient air monitoring of mercury presents significant challenges because of the typically low concentrations (ng/m(exp 3)) encountered and numerous opportunities for sample contamination or analyte loss. There are presently no EPA-approved protocols for such sampling and analysis. Elemental mercury was used in large quantities at a nuclear weapons plant in Oak Ridge, Tennessee between 1950 and 1963 in a process similar to chloralkali production. Soil and water contamination with mercury were known to be present at the facility but outdoor ambient air contamination had not been investigated prior to the present study. In addition, one large building still contained original process equipment with mercury residuals. The objectives of this study were to establish a monitoring network for mercury which could be used (1) to demonstrate whether or not human health and the environment was being protected, and (2) to establish a decommissioning activities at the facility. DOE

N92-19994# Radian Corp., Research Triangle Park, NC.
EXAMPLE EMISSION INVENTORY DOCUMENTATION FOR POST-1987 OZONE STATE IMPLEMENTATION PLANS (SIPS)
G. Brooks and G. Reeves Oct. 1989 412 p
(Contract EPA-68-02-4392)
(PB92-112176; EPA/450/4-89/018) Avail: NTIS HC/MF A18 CSCL 13B

Presented here is a supplement to recent U.S. Environmental Protection Agency (EPA) guidance on compiling emission inventories for reactive volatile organic compounds (VOC), oxides of nitrogen (NOx), and carbon monoxide (CO), for use in developing post-1987 State Implementation Plans (SIPs) for demonstrating attainment of the ambient ozone standards. Given here is an example emissions inventory for reactive VOC, NOx, and CO, which has been compiled and documented for a fictitious ozone nonattainment area called Ozoneville. This updates and supersedes an earlier EPA inventory guidance document for ozone SIPs entitled Example Emission Inventory Documentation for 1982 Ozone SIPs. Author

N92-19999# Environmental Protection Agency, Research Triangle Park, NC. Environmental Criteria and Assessment Office.
INDOOR AIR-ASSESSMENT: AN INVENTORY OF INDOOR AIR QUALITY RESEARCH IN THE UNITED STATES: 1989 - 1990
T. Pierson and D. Greenwood Dec. 1990 214 p
(PB92-114545; EPA/600/8-90/080F; ECAO-R-0516) Avail: NTIS HC/MF A10 CSCL 13B

A survey of indoor air quality research projects in the U.S. was undertaken using a standard form and keyword list. In response to the request for participation, 110 completed forms were received from 69 principal investigators at 34 institutions. Universities has the largest number of IAQ research projects (23), followed by EPA (20), other Federal agencies (18), state (18), national laboratories (15), and private research organizations (12). The results of the inventory will provide EPA and NATO-CCMS with information on the current directions and funding levels of IAQ research in the United States. Although the information is preliminary, it can be useful to EPA in planning future research. Author

N92-20000# Pacific Northwest Lab., Richland, WA.
CHARACTERISTICS OF THE VOLATILE ORGANIC COMPOUNDS: ARID INTEGRATED DEMONSTRATION SITE
G. V. Last, R. J. Lenhard, B. N. Bjornstad, J. C. Evans, K. R. Roberson, F. A. Spane, J. E. Amonette, and M. L. Rockhold Oct. 1991 103 p
(Contract DE-AC06-76RL-01830)
(DE92-003882; PNL-7866) Avail: NTIS HC/MF A06

The Volatile Organic Compounds - Arid Integrated Demonstration Program (VOC-Arid ID) is targeted at demonstration and testing of technologies for the evaluation and cleanup of volatile organic compounds and associated contaminants at arid DOE sites. The initial demonstration site is an area of carbon tetrachloride (CCl4) contamination located near the center of the Hanford Site. The movement of CCl4 and other volatile organic contaminants in the subsurface is very complex. The problem at the Hanford Site is further complicated by the concurrent discharge of other waste constituents including acids, lard oil, organic phosphates, and transuranic radionuclides. In addition, the subsurface environment is very complex, with large spatial variabilities in hydraulic properties. A thorough understanding of the problem is essential to the selection of appropriate containment, retrieval, and/or in situ remedial technologies. The effectiveness of remedial technologies depends on knowing where the contaminants are, how they are held up in a given physical and chemical subsurface environment; and knowing the physical, chemical, and microbiological changes that are induced by the various remedial technologies. DOE

N92-20013# Department of Energy, Richland, WA.
STANDARD REVIEW PLAN FOR THE REVIEW OF ENVIRONMENTAL RESTORATION REMEDIAL ACTION QUALITY ASSURANCE PROGRAM PLANS
Sep. 1991 224 p
(DE92-004254; DOE/RL-91-36) Avail: NTIS HC/MF A10

This plan establishes both the scope of the review and the acceptance criteria to be utilized for the review of Quality Assurance Program Plans (QAPPs) developed in accordance with the requirements of DOE/RL-90-28. DOE/RL-90-28, the Environmental Restoration Remedial Action (ERRA) Quality Assurance Requirements Document (QARD) defines all quality assurance (QA) requirements governing activities that affect the quality of the ERRA program at the Hanford Site. These requirements are defined in three parts, Part 1 of Quality Management and Administration tasks, Part 2 for Environmental Data Operations, and Part 3 of the Design and Construction of items, systems, and facilities. The purpose of this document is to identify the scope of the review by the DOE Field Office, Richland staff, and establish the acceptance criteria that the DOE Field Office, Richland staff will utilize to evaluate the participant QAPPs. Use of the standard review plan will (1) help ensure that participant QAPPs contain the information required by DOE/RL-90-28, (2) aid program participant and DOE Field Office, Richland staff in ensuring that the information describing the participant's QAPP is complete, (3) help persons regarding DOE/RL-90-28 to locate information, and (4) contribute to decreasing the time needed for the review process. In addition, the Standard Review Plan (SRP) ensures the quality and uniformity of the staff reviews and presents a well-defined base from which to evaluate compliance of participant quality programs against DOE/RL-90-28. DOE

N92-20014# Systems Applications, Inc., San Rafael, CA.
ASSESSMENT OF COMPUTER MODELS FOR ESTIMATING VEHICLE EMISSION FACTORS. VOLUME 3: SENSITIVITY ANALYSES OF THE MOBILE4 AND EMFAC7E EMISSION MODELS Final Report

19 Jul. 1991 157 p Sponsored in part by Coordinating Research Council, Inc., Atlanta, GA
(PB92-113075; SYSAPP-91/091C) Avail: NTIS HC/MF A08; also available in set of 3 reports HC/MF E99 as PB92-113042
CSCL 13B

In the authors' comparative assessment of the EMFAC7E and MOBILE4 emission models (Volume 2), they identified certain key parameters and model assumptions as important in the formulation of the models. The influence of these parameters and assumptions on the predicted emission rates can be examined in a sensitivity analysis. The results of the analysis (given here), distinguish these parameters and assumptions that have a significant effect on the emission rates of the models and those that do not. These results, consisting of observed changes in the emission rates, are contrasted with the expected changes in the emission rates. The descrepancies between observed and expected changes are then used as a tool for the evaluation of each model. Author

N92-20021# Geological Survey, Denver, CO.
SUMMARY OF THE NATIONAL ATMOSPHERIC DEPOSITION PROGRAM/NATIONAL TRENDS NETWORK INTERSITE-COMPARISON PROGRAM, NOVEMBER 1978 - NOVEMBER 1989
J. D. Gordon, T. C. Willoughby, and L. J. Schroder 1991 33 p
(PB92-107135; USGS/WRI-91-4061) Avail: NTIS HC/MF A03
CSCL 13B

Intersite-comparison studies have been used since Nov. 1978 to assess the accuracy and precision of pH and specific-conductance measurements made by NADP/NTN site operators. A total of 24 intersite-comparison studies was completed as of Nov. 1989. The results are summarized of the studies and the measurement-accuracy criteria is evaluated. The pH and specific-conductance measurements made during intersite-comparison studies were primarily evaluated using two methods of analysis. The first method of analysis evaluated site-operator reported values in terms of the measurement-accuracy criteria established by the Network Operations Subcommittee. The second method of analysis evaluated the differences between site-operator reported values and network median values.
Author

N92-20022*# Pennsylvania State Univ., University Park. Earth System Science Center.
REGIONAL CLIMATE CHANGE PREDICTIONS FROM THE GODDARD INSTITUTE FOR SPACE STUDIES HIGH RESOLUTION GCM Final Report, May 1989 - Oct. 1991
Robert G. Crane and B. C. Hewitson 1991 54 p
(Grant NAG5-1133)
(NASA-CR-190037; NAS 1.26:190037) Avail: NTIS HC/MF A04
CSCL 13B

A new diagnostic tool is developed for examining relationships between the synoptic scale circulation and regional temperature distributions in GCMs. The 4 x 5 deg GISS GCM is shown to produce accurate simulations of the variance in the synoptic scale sea level pressure distribution over the U.S. An analysis of the observational data set from the National Meteorological Center (NMC) also shows a strong relationship between the synoptic circulation and grid point temperatures. This relationship is demonstrated by deriving transfer functions between a time-series of circulation parameters and temperatures at individual grid points. The circulation parameters are derived using rotated principal components analysis, and the temperature transfer functions are based on multivariate polynomial regression models. The application of these transfer functions to the GCM circulation indicates that there is considerable spatial bias present in the GCM temperature distributions. The transfer functions are also used to indicate the possible changes in U.S. regional temperatures that could result from differences in synoptic scale circulation between a 1XCO2 and a 2xCO2 climate, using a doubled CO2 version of the same GISS GCM. Author

N92-20028# California Univ., Davis. Dept. of Land, Air and Water Resources.
SIERRA OZONE IMPACT ASSESSMENT STUDY Final Report
J. J. Carroll Jun. 1991 43 p Sponsored in part by California State Air Resources Board, Sacramento
(Contract ARB-A933-097)
(PB92-104660; ARB-R-91/468) Avail: NTIS HC/MF A03
CSCL 13B

The Sierra Cooperative Ozone Impact Assessment Study (SCOIAS) is a multi-agency effort involving the University of California, Davis (UCD), U.S. Forest Service, and California Air Resources Board. The objectives of the SCOIAS are to monitor air quality and foliar damage in mixed-conifer forests in the Sierra Nevada of California, and to characterize the levels of ozone that forest trees are exposed to throughout the year. In the first year, UCD established air quality monitoring stations in five National Forests (NF) to measure the concentration of ozone and a number of meteorological variables (i.e., wind speed and direction, temperature, humidity). The five stations are located at: Mountain Home (Sequoia NF), Jerseydale (Sierra NF), Five-Mile (Stanislaus NF), Sly Park (El Dorado NF), and White Cloud (Tahoe NF). Through March 20, 1991, 433 site-days of data were collected, and the loss of data due to instrument malfunction was less than eight percent of the cumulative sampling period. To date, the highest ozone concentrations were observed in October 1990, when hourly averaged concentrations exceeded 100 ppbv at Mountain Home, Jerseydale and White Cloud. In winter, ozone concentrations were generally below 80 ppbv. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-19088# Rice Univ., Houston, TX. Dept. of Space Physics and Astronomy.
DEVELOPMENT OF A MAGNETOSPHERIC SPECIFICATION MODEL. VOLUME 2: APPENDICES A, B, C, D, E Final Report, 15 Nov. 1987 - 31 Mar. 1990
J. W. Freeman, R. A. Wolf, R. W. Spiro, G.-H. Voigt, and B. A. Hausman 30 Jun. 1991 414 p
(Contract F19628-87-K-0001)
(AD-A244420; PL-TR-91-2276-(2)-Vol-2; AD-E200820) Avail: NTIS HC/MF A18 CSCL 04/1

Rice University has developed a practical computer model that is capable of specifying electron and ion fluxes in the middle magnetosphere during geomagnetic storms. The model, called the Magnetospheric Specification Model (MSM), used ground-based and satellite data from the Space Forecast Center-Environment Data Base to establish initial and boundary conditions and to determine input parameters for the magnetic and electric field models. These input values are updated every 15 minutes, and new output fluxes are computed for the same times. The primary function of the MSM is the specification of fluxes of 1-100 KeV electrons in the geostationary orbit region. However, it is also designed to specify a broad range of additional parameters for the global ionospheric-magnetospheric system, including fluxes of 1-50 KeV ions, auroral electron precipitation, and ionospheric electric fields. The model is accompanied by an application program that allows specification of fluxes at an arbitrary point in the magnetosphere within the modeling region. Consistent with its primary function, the MSM has been tested against spacecraft data for 2 substantial storms and has been shown to produce a good characterization of the enhancements of 40 KeV electron fluxes in the equatorial plane. The model never failed to predict high fluxes when they were observed, although it did predict high fluxes in some cases when they were not observed and it did fail to predict flux dropouts observed by the spacecraft. The MSM is ready for adaptation for use in an operational setting where the

goal is real time and retrospective specification of hazardous charge particle fluxes associated with geomagnetic storms. GRA

N92-19222# Cologne Univ. (Germany, F.R.). Inst. fuer Geophysik und Meteorologie.
NUMERICAL EXPERIMENTS ON THE CONVECTION IN COMPRESSIBLE MEDIA [NUMERISCHE EXPERIMENTE ZUR KONVEKTION IN KOMPRESSIBLEN MEDIEN]
Volker Steinbach 1991 142 p In GERMAN
(Mitt-79; ISSN-0069-5882; ETN-92-90726) Avail: NTIS HC/MF A07

The consequences for compressible convection flows of the recently formulated depth dependence of the thermodynamic parameters of the Earth mantle, were studied. Convection flows as well as convection in the high grade nonlinear domain of higher supercritical Rayleigh numbers were investigated using stationary and time dependent numerical models. At higher dissipation numbers and/or higher surface temperatures differences are found between the present model and models using constant thermodynamic parameters. The depth dependence of these parameters also has important consequences for the dynamics of the lower Earth model and the D layer. ESA

N92-19230# Stockholm Univ. (Sweden). Dept. of Meteorology.
DIABATIC DIGITAL FILTERING INITIALIZATION OF THE HIRLAM MODEL
Xiang-Yu Huang 6 Jun. 1991 26 p
(Grants G-GU-1705-311; E-EG-2923-300)
(DM-58; ISSN-0349-0467; ETN-92-90724) Avail: NTIS HC/MF A03

The digital filtering initialization scheme used by Lynch and Huang (1991) (LH91) is extended to include diabatic processes. The case chosen to demonstrate Diabatic Digital Filtering Initialization (DDFI) is the same one as in LH91, in which an intense low crossed Denmark and Southern Sweden on 5-6 Sep. 1985. The HIRLAM baroclinic model is used. The new scheme gives a lower noise level in the forecast and a better organized initial pressure tendency field than the original scheme does. The improvements are mainly achieved over a mountainous region. The implementation of the scheme is very easy, but a consistent treatment of boundaries of the limited area model requires further investigations. ESA

N92-19292# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere.
SIMPLE MODELS FOR THE DESCRIPTION OF TURBULENCE IN THE ATMOSPHERIC BOUNDARY LAYER
Anne M. Jochum Nov. 1990 82 p In GERMAN; ENGLISH summary
(DLR-FB-90-17; ISSN-0939-2963; ETN-92-90731) Avail: NTIS HC/MF A05; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 27 DM

Simple methods for classifying atmospheric boundary layer states and describing atmospheric boundary layer turbulence over homogeneous land surfaces are reviewed. A new method is proposed to evaluate turbulence parameters from routine meteorological observations. This method is based on a combination of similarity theory and available parameterization schemes for surface fluxes and atmospheric boundary layer depth. It consists of a basic module of a simple method to predict and evaluate aircraft reaction in turbulent air on a routine basis. ESA

N92-19298 Royal Netherlands Meteorological Inst., De Bilt.
ANALYSIS OF REGIONAL DIFFERENCES OF FORECASTS WITH THE MULTI-LAYER AMT-MODEL IN THE NETHERLANDS
E. I. F. deBruijn, Li-Tao Guang, and Gao Kang (Meteorological Bureau of Shanxi Province, Taiyuan, China) 1990 26 p
(KNMI-WR-90-02; ISSN-0169-1651; ETN-92-91032) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan, Netherlands

The research of predicting regional differences in atmospheric boundary layer parameters with the multilayers AMT (Air Mass Transformation) model is described. The results are compared with the model output of the European Center for Medium Range Weather Forecasts (ECMWF) numerical weather prediction. The background of this research is given. Three case studies are discussed and an objective comparison is given. The ATT model is able to predict regional differences in Atmospheric Boundary Layer parameters but it has the same skill as the ECMWF model. Nevertheless the AMT model is a useful tool, which will give the forecaster a quick indication if regional differences will occur in the next 12 hours. ESA

N92-19330# Army Cold Regions Research and Engineering Lab., Hanover, NH.
GEOPHYSICAL INVESTIGATIONS OF AN ANOMALOUS UNFROZEN ZONE, CARIBOU PEAK, ALASKA
Daniel E. Lawson, Steven A. Arcone, and Charles M. Collins Oct. 1991 29 p
(AD-A244257; CRREL-91-17) Avail: NTIS HC/MF A03 CSCL 08/8

Occurrence of unfrozen materials and groundwater flow on a north-facing slope in interior Alaska is important to recognize, both for predicting the spatial distribution of perennially frozen ground as well as for understanding watershed hydrology. An anomalous unfrozen zone or talik was located on the northern slope of Caribou Peak by drilling in April 1985. Impulse radar surveying of the area immediately adjacent to this drill hole, as well as one three transects upslope of its locations, revealed that the unfrozen zone is the result of groundwater flow in the bedrock along a relatively planar zone, interpreted as a fracture. This fracture and two others located by radar are continuous in the direction of the slope, trending generally N 20 deg E and dipping about 9 deg east. Geologic logs indicate that the drill hole intersected a fracture in the bedrock, a quartz-muscovite schist, at a depth of about 8.5 to 9.0 m. Downhole measurements show ground temperatures at this depth are generally uniform and slightly above freezing throughout the year, suggesting continuous flow of groundwater within the planar structure. Analysis of the freezing point of the groundwater sample indicates normal freezing beginning at 0 C, while ion chromatography indicated that the water was fresh and not highly mineralized. Vegetation patterns, coupled with the borehole location and fracture orientation, suggest that flow originates within the upper and central parts of the peak and discharges into the valley of Poker Creek. The source of the ground water is unknown, but appears to be an aquifer in the south facing, nonpermafrost side of Caribou Peak that is intersected by the north-south striking fractures. GRA

N92-19409# Ecole Nationale Superieure des Telecommunications, Paris (France).
IMAGE SIMULATION BY MEANS OF MICROWAVE RADIOMETRY APPLIED TO ATMOSPHERIC SOUNDING FOR SECOND GENERATION METEOSAT Ph.D. Thesis [SIMULATION D'IMAGES OBTENUES PAR RADIOMETRIE MICRO-ONDE: APPLICATION AU SONDAGE ATMOSPHERIQUE POUR METEOSAT SECONDE GENERATION]
Laurent Phalippou 1991 276 p In FRENCH Sponsored by CIFRE
(Telecom-Paris-91-E-002; ISSN-0751-1353; ETN-92-90672)
Avail: NTIS HC/MF A13

Ways of optimizing the performance of a Meteosat Microwave Sounder (MMWS) are described. Special emphasis is given to the optimization of antenna performance. Software developed to simulate and analyze the measurements provided by MMWS during observation of a real meteorological situation is presented. For a particular meteorological event, that occurred on 15 Oct. 1987, the instrument and the satellite are simulated, taking the antenna shape, sweep, spatial sampling radiometric noise, and satellite movement into consideration. The fields measured by MMWS show that hydrometeor contamination is important over all channels of the MMWS with the exception of channel 1. ESA

N92-19454# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
SOURCES AND CAUSES OF UPPER ATMOSPHERIC DISTURBANCES Final Report, 1 May 1988 - 30 Apr. 1991
Min-Chang Lee 30 Apr. 1991 4 p
(Grant AF-AFOSR-0217-88; AF Proj. 2310)
(AD-A243824; AFOSR-91-0951TR) Avail: NTIS HC/MF A01
CSCL 04/1

In the past three years we conducted theoretical and experimental studies of some naturally occurring ionospheric disturbances. Periodic amplitude variations of satellite beacon signals were observed as the precursors of the plumes of equatorial ionospheric irregularities. Some outstanding features of explosive spread F reported in Woodman and La Hoz and Woodman and Kudeki can be reasonably understood in terms of the lightning induced electromagnetic effects. The spectral broadening of monochromatic VLF radio signals detected by satellites in the topside ionospheric was attributed to the nonlinear scattering of waves off ionospheric density irregularities. Furthermore, the irregularity anisotropy can give rise to prominent effects on the Faraday polarization fluctuations of linearly polarized radio signals. This fact can be used to develop the radio diagnostics of the anisotropic nature of ionospheric irregularities, namely, to determine the geometry of field-aligned density irregularities. Efforts were also made on the reduction of ionospheric effects on the polarization measurements during satellite tracking. GRA

N92-19535 Columbia Univ., New York, NY.
INVESTIGATIONS INTO THE DEVELOPMENT OF CONTINENT-OCEAN TRANSFORM BOUNDARIES Ph.D. Thesis
Juan Manuel Lorenzo 1991 163 p
Avail: Univ. Microfilms Order No. DA9127916

A two-stage evolutionary model is proposed to explain the tectonic, stratigraphic, and igneous features observed along continent-ocean transform boundaries. New data sets are analyzed consisting of: (1) 14,000 km of multi-channel and single-channel seismic (MCS) reflection profiles for the Falkland/Malvinas Plateau (South Atlantic); and (2) a 200 km of deep penetration MSC profile, five expanded spread profiles (ESP's), physical property values from ODP Site 763, and shipboard gravity data for the Exmouth Plateau (N.W. Australia). Four major depositional sequences are defined and mapped for the Falkland Plateau. In the Exmouth, seismic reflectors are tied to lithological and age unit boundaries using ESP-derived physical properties. ESP models are shown comparable to in situ downhole derived measurements. During the first stage, at the time of rifting, extensional detachment surfaces develop at a high angle to the future transform and are later sheared by strike-slip faulting. Final transform rupture occurs within a 10-15 km region, attended by large fault block rotation and mafic intrusions in conditions of pure shear. During the second stage, the continental rim is underplated when the oceanic ridge abuts the continent. This has produced a 10 km thick, 7.3 km/s layer under the Exmouth margin, resulting in a permanent isostatic uplift of the crust and tilting of syn-rift sediments. Gravity modeling suggests this layer comprises a 3 g/cu cm mixture of mafic and felsic rocks. The thermal evolution for the transform is examined using a two-dimensional heat conduction model, and the results are presented. Dissert. Abstr.

N92-19663# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
LOWER TROPOSPHERIC PROFILING: NEEDS AND TECHNOLOGIES. A SYMPOSIUM TO CRITICALLY REVIEW AND EVALUATE SCIENTIFIC NEEDS AND ASSESS CURRENT AND PROJECTED TECHNOLOGIES
1991 222 p Symposium held in Boulder, CO, 10-13 Sep. 1991
(PB92-102565) Avail: NTIS HC/MF A10 CSCL 04A

The main topics discussed at the symposium include the following: climate dynamics; atmospheric chemistry; lidar; radar and sodar; radio acoustic sounding system (RASS); wind profilers, passive and in situ methods; networks and integrated systems; models, algorithms, and theory. GRA

N92-19735*# Michigan Univ., Ann Arbor. Dept. of Civil and Environmental Engineering.
CRUSTAL DEFORMATION ALONG THE SAN ANDREAS, CALIFORNIA Final Technical Report, 1 Feb. 1991 - 31 Jan. 1992
Victor C. Li 2 Mar. 1992 24 p
(Grant NAG5-1398)
(NASA-CR-190061; NAS 1.26:190061) Avail: NTIS HC/MF A03
CSCL 08G

The goal is to achieve a better understanding of the regional and local deformation and crustal straining processes in western North America, particularly the effects of the San Andreas and nearby faults on the spatial and temporal crustal deformation behavior. Construction of theoretical models based on the mechanics of coupled elastic plate, viscoelastic foundation and large scale crack mechanics provide a rational basis for the interpretation of seismic and aseismic anomalies and expedite efforts in forecasting the stability of plate boundary deformation. Special focus is placed on the three dimensional time dependent surface deformation due to localized slippage in a elastic layer coupled to a visco-elastic substrate. The numerical analysis is based on a 3-D boundary element technique. Extension to visco-elastic coupling demands the derivation of 3-D time dependent Green's function. This method was applied to analyze the viscoelastic surface displacements due to a dislocated embedded patch. Surface uplift as a function of time and position are obtained. Comparisons between surface uplift for long and short dislocated patches are made. Author

N92-19773*# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
SEA ICE-ATMOSPHERE INTERACTION. APPLICATION OF MULTISPECTRAL SATELLITE DATA IN POLAR SURFACE ENERGY FLUX ESTIMATES Annual Progress Report
Konrad Steffen, Jeff Key, Jim Maslanik, Marcel Haefliger, and Chuck Fowler Feb. 1992 47 p
(Grant NAGw-2158)
(NASA-CR-189923; NAS 1.26:189923) Avail: NTIS HC/MF A03
CSCL 04A

Satellite data for the estimation of radiative and turbulent heat fluxes is becoming an increasingly important tool in large-scale studies of climate. One parameter needed in the estimation of these fluxes is surface temperature. To our knowledge, little effort has been directed to the retrieval of the sea ice surface temperature (IST) in the Arctic, an area where the first effects of a changing climate are expected to be seen. The reason is not one of methodology, but rather our limited knowledge of atmospheric temperature, humidity, and aerosol profiles, the microphysical properties of polar clouds, and the spectral characteristics of the wide variety of surface types found there. We have developed a means to correct for the atmospheric attenuation of satellite-measured clear sky brightness temperatures used in the retrieval of ice surface temperature from the split-window thermal channels of the advanced very high resolution radiometer (AVHRR) sensors on-board three of the NOAA series satellites. These corrections are specified for three different 'seasons' and as a function of satellite viewing angle, and are expected to be applicable to the perennial ice pack in the central Arctic Basin. D.R.D.

N92-19776*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
IONOSPHERIC PLASMA OUTFLOW IN RESPONSE TO TRANSVERSE ION HEATING Semiannual Report, Jul. 1991 - Jan. 1992
Nagendra Singh 1992 42 p
(Grant NAGw-2579)
(NASA-CR-190030; NAS 1.26:190030) Avail: NTIS HC/MF A03
CSCL 04A

The transverse heating of H(+) ions and the consequent dynamics of the polar wind were investigated. Additionally, the effect of transverse ion heating was examined using a particle code. D.R.D.

N92-19815# Florida State Univ., Tallahassee. Dept. of Meteorology.
PREDICTION OF GLOBAL CLOUD COVER WITH A VERY HIGH RESOLUTION GLOBAL SPECTRAL MODEL Annual Report, 15 Nov. 1990 - 14 Nov. 1991
T. N. Krishnamurti 14 Nov. 1991 37 p
(Grant AF-AFOSR-0023-91; AF Proj. 2310)
(AD-A244083; AFOSR-91-0994TR) Avail: NTIS HC/MF A03 CSCL 04/1

Discussions of the following topics are presented: (1) inclusion of anvil rain in a cumulus parameterization scheme; and (2) a global model that includes fractional cloud cover prediction methods and outgoing long wave radiation. These two studies are closely related in that the first addresses a substantial improvement for our definition of tropical cloud cover, while the second treats its application over the global belt via 4 to 6 day long prediction experiments. GRA

N92-19866# Swedish Inst. of Space Physics, Kiruna.
KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 91/1-3, JANUARY - MARCH 1991
S. Kirkwood 1991 48 p
(PB92-125068) Avail: NTIS HC/MF A03 CSCL 08G

A collection of results from ground-based more or less continuous measurements of upper atmosphere variables carried out at the Swedish Institute of Space Physics is presented. The following are included: tables of Jan. - Mar. 1991 geomagnetic K-indices and all-sky camera data; and reproductions for Jan. - Mar. 1991 magnetogram plots and riometer recordings. GRA

N92-19910 Utah Univ., Salt Lake City.
PARAMETERIZATION OF RADIATIVE PROCESSES IN VERTICALLY NONHOMOGENEOUS MULTIPLE SCATTERING ATMOSPHERES Ph.D. Thesis
Qiang Fu 1991 268 p
Avail: Univ. Microfilms Order No. DA9136304

A radiation model has been developed to calculate the radiative fluxes and heating rates in plane parallel, vertically nonhomogeneous, multiple scattering atmospheres with an accuracy of better than 5 percent. This scheme is appropriate for use in climate and numerical prediction models to study the effect of cloud and radiation interactions. Parameterization of nongray gaseous absorption in vertically nonhomogeneous atmospheres has been developed based upon the correlated K-distribution method. The entire radiation spectrum is divided into 18 intervals: 6 in the solar and 12 in the infrared. By using a minimum number of quadrature points within each wavelength interval to represent the gaseous absorption and to treat overlap, we need to perform 121 spectral calculations for each vertical profile to obtain total radiative fluxes and heating rates. The treatment of gaseous absorption introduces errors less than 0.05 K/day in the heating rates below 30 km and relative errors less than 0.5 percent in the fluxes. The single-scattering properties of water/ice clouds have been parameterized in terms of the effective size and liquid/ice water contents, based on Mie-scattering/ray-tracing computations with the best available size distributions. The parameterization gives an accuracy within about 1 percent in the solar and 5 percent in the infrared. By using the delta-four-stream approximation, a single algorithm has been developed for radiative transfer calculations. For vertically nonhomogeneous atmospheres, this code is numerically stable and computationally efficient. The accuracy of the algorithm is generally better than 5 percent, but it can produce more accurate results in the limit of no scattering. Compared with line-by-line results from clear-sky longwave calculations when all constituents were included, the errors in heating rates calculated by the new radiation model are less than 0.1 K/day in the troposphere and lower stratosphere. The errors in radiative fluxes are less than 1 percent both at the earth's surface and the top of the atmosphere. Dissert. Abstr.

N92-19942# Pacific Northwest Lab., Richland, WA.
A FIELD STUDY OF THE EFFECTS OF INHOMOGENEITIES OF SURFACE SENSIBLE AND LATENT HEAT FLUXES
J. C. Doran, F. J. Barnes, R. L. Coulter, and T. L. Crawford (Oak Ridge National Lab., TN.) Jan. 1992 15 p Presented at the 72nd American Meteorological Society Conference, Atlanta, GA, 5-10 Jan. 1992
(Contract DE-AC06-76RL-01830)
(DE92-006731; PNL-SA-19933; CONF-920134-5) Avail: NTIS HC/MF A03

In recent years, the problem of characterizing turbulent fluxes of heat, momentum, and moisture over inhomogeneous surfaces has received increasing attention. This issue is relevant to the performance of general circulation models (GCMs), in which a single grid element can encompass a variety of surface and topographical features. Although considerable progress has been made in describing the energy balance at a surface partially covered by vegetation, less is known about how to treat adjacent regions of sharply contrasting surface characteristics. One difficulty is the scarcity of suitable data sets with which to study the problem, particularly on scales of tens to hundreds of kilometers. DOE

N92-19955# South Carolina Univ., Columbia. Dept. of Civil Engineering.
INVESTIGATION OF SUBSURFACE EXPLORATION METHODS FOR PREVAILING GEOLOGIC CONDITIONS IN SOUTH CAROLINA, PHASE 2 Final Report
R. L. Baus Mar. 1991 120 p Sponsored in part by South Carolina Dept. of Highways and Public Transportation, Columbia; and Federal Highway Administration, Columbia
(PB92-102706; RR-F91-126) Avail: NTIS HC/MF A06 CSCL 08G

A pile load testing program is summarized. A total of 7 static and 12 dynamic load tests were performed on driven friction piles in the Atlantic Coastal Plain region of South Carolina. The primary objectives were: (1) to correlate measured static axial capacity of single driven piles with field penetration test data; and (2) to evaluate dynamic methods for predicting static axial pile capacity. A summary is given of the project data base, along with results of pile load tests, and comparisons of measured and predicted pile capacities. Pile capacity prediction methods used are based on standard penetration (SPD) and cone penetration (CPT) data, dynamic formulas, wave equation analysis, and pile driving analyzer (PDA) results. Comparisons of measured and predicted pile capacities are made for the purpose of evaluating prediction methods for driven piles in the Pee Dee area of the Atlantic Coastal Plain region of South Carolina. Author

N92-19962# Swedish Inst. of Space Physics, Kiruna.
KIRUNA GEOPHYSICAL DATA. DATA SUMMARY, 10-12 OCTOBER TO DECEMBER 1990
S. Kirkwood 1991 41 p
(PB92-109529) Avail: NTIS HC/MF A03 CSCL 08G

Kiruna Geophysical Data is a collection of results of ground based more or less continuous measurements of upper atmosphere variables carried out a Swedish Institute of Space Physics. The objective with the data summary is to present current geophysical data, related to polar upper atmospheric conditions, to those who require it for their research work. Author

N92-19990# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
THE LONGITUDINAL-TRANSVERSE SPATIAL COHERENCE FUNCTION FOR A SPHERICAL WAVE PROPAGATING THROUGH HOMOGENEOUS ATMOSPHERE TURBULENCE: IMPLICATIONS FOR RASS
Richard J. Lataitis Aug. 1991 25 p
(PB92-104645; NOAA-TM-ERL-WPL-206) Avail: NTIS HC/MF A03 CSCL 04A

An expression is derived for the longitudinal transverse, second order, spatial coherence function for a spherical wave propagating through homogeneous turbulence. The development parallels that of Nalbandyan and Tararski (1977), who considered the same problem for plane waves, and is general enough to allow for a nonuniform distribution of turbulence along the propagation path. The results indicate that the longitudinal coherence length for a

spherical wave is identical to that for a plane wave. It was found that the path-weighting of turbulence strength for the longitudinal coherence length is the same for both plane and spherical waves, consisting of a uniform weighted local component about the range of interest and a uniformly weighted path-integrated component. Earlier calculations of the longitudinal coherence length with implications for radio acoustic sounding system (RASS) assumed uniform turbulence and used exceedingly small acoustic C(sub n, exp 2) values. The procedure yielded long coherence lengths and led to the conclusion that the RASS echo power was not significantly affected by the degradation of the longitudinal coherence of the acoustic wave. The present study has reached the same conclusion using the more appropriate values of C(sub n, exp 2) and including its variability with height. Author

N92-20025# Sydney Univ. (Australia). School of Civil and Mining Engineering.
SIMILITUDE REQUIREMENTS OF SNOWDRIFT MODELLING FOR ANTARCTIC ENVIRONMENT,
D. H. Kim, K. C. S. Kwok, and Helmut F. Rohde (Rohde, Helmut and Partners, Sydney, Australia) Feb. 1991 72 p Sponsored by Australian Research Council, Belconnen
(PB92-104157; R-634) Avail: NTIS HC/MF A04 CSCL 08L

A closed-circuit turbulent boundary layer Snowdrift Wind Tunnel (S.W.T.) was built in the School of Civil and Mining Engineering, the University of Sydney, for the study of Antarctic snowdrifting. Scaled turbulent boundary layer winds, representing prototype summer and winter conditions (coastal sites of Australian Antarctic territory), were generated. Sodium bicarbonate was chosen as model snow out of a number of different materials used. The results of snowdrift simulation using the model snow were compared with the field measurement taken by Mitsuhashi (1982). Based on the comparison of experimental results and field study results, the significance and relevance of various similitude parameters to the snowdrift modeling are discussed. These parameters include flow and geometry, angle of repose, particle trajectory, and time scale. In particular, the similitude requirements of scaled turbulent boundary layer wind, which is believed to be one of the important modeling requirements, are discussed in detail. Author

N92-20044*# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
HOW WELL CAN REGIONAL FLUXES BE DERIVED FROM SMALLER-SCALE ESTIMATES? Semiannual Progress Report
Kathleen E. Moore, David R. Fitzjarrald, and John A. Ritter 19 Mar. 1992 35 p
(Contract NCC1-135)
(NASA-CR-190056; NAS 1.26:190056) Avail: NTIS HC/MF A03 CSCL 04A

Regional surface fluxes are essential lower boundary conditions for large scale numerical weather and climate models and are the elements of global budgets of important trace gases. Surface properties affecting the exchange of heat, moisture, momentum and trace gases vary with length scales from one meter to hundreds of km. A classical difficulty is that fluxes have been measured directly only at points or along lines. The process of scaling up observations limited in space and/or time to represent larger areas was done by assigning properties to surface classes and combining estimated or calculated fluxes using an area weighted average. It is not clear that a simple area weighted average is sufficient to produce the large scale from the small scale, chiefly due to the effect of internal boundary layers, nor is it known how important the uncertainty is to large scale model outcomes. Simultaneous aircraft and tower data obtained in the relatively simple terrain of the western Alaska tundra were used to determine the extent to which surface type variation can be related to fluxes of heat, moisture, and other properties. Surface type was classified as lake or land with aircraft borne infrared thermometer, and flight level heat and moisture fluxes were related to surface type. The magnitude and variety of sampling errors inherent in eddy correlation flux estimation place limits on how well any flux can be known even in simple geometries. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-19039# Clemson Univ., SC. Dept. of Physics and Astronomy.
WIND PROFILER INVESTIGATIONS OF LOW-FREQUENCY GRAVITY-INERTIA WAVES AROUND THE JET STREAM Final Technical Report, 1 Aug. 1988 - 2 Dec. 1991
M. F. Larsen 2 Dec. 1991 20 p
(Contract F49620-88-C-0121)
(AD-A244383; AFOSR-91-1032TR) Avail: NTIS HC/MF A03 CSCL 04/2

The structure and dynamics of inertia-gravity waves in the upper troposphere and lower stratosphere have been studied using data from a wind profiler that was temporarily located in Kansas, data from the Arecibo Observatory 430 MHz radar, data from the SOUSY-VHF-Radar located in Germany, and data from the MU radar in Japan. The radar data has shown that low frequency inertia-gravity wave oscillations are a persistent feature of the region near the tropopause and in the lower stratosphere. Some of our analysis indicates that the wave structure is likely generated by the interaction of the surface winds and the orography. However, the frequency in the earth-fixed frame corresponds to a period of 24 hr and is not zero. The latter effect is presumably due to the strong vertical circulation near the tropopause with a reversal in direction at the height of the wind maximum. The observed vertical velocities are larger than expected but otherwise agree with the predictions of earlier theoretical analyses. We have also investigated the relationship between turbulent layers in the upper troposhere and lower stratosphere ad the low frequency inertia-gravity waves. The turbulent layers are observed to move in the same direction as the phase progression of the background waves, indicating that the turbulent layers occur at a particular wave phase where the wave-perturbed flow becomes unstable. GRA

N92-19100# Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
MESOSCALE VERTICAL VELOCITIES GENERATED BY STRESS CHANGES IN THE BOUNDARY LAYER: LINEAR THEORY
G. A. Dalu, M. Baldi, R. A. Pielke, J. T. Lee, and M. Colacino 15 Jul. 1991 18 p Previously announced in IAA as A92-17742
(Contract N00014-88-K-0029; NSF ATM-89-15265)
(AD-A244146) Avail: NTIS HC/MF A03 CSCL 04/2

The mesoscale vertical velocity induced by stress changes in the surface layer is evaluated as a function of the size of the rough patch in relation to environmental parameters. The nature of the flow perturbation strongly depends on the relation between the width of the rough patch and the two natural scales of the flow, i.e., the inverse inertia wave number and the inverse of the Scorer parameter. When the width of the rough patch is comparable to the inverse inertia wave number or larger, the atmospheric perturbation is trapped, the vertical scale equals the depth of the stress surface layer, and the horizontal scale equals the Rossby radius. When the width of the rough patch is larger than the inverse of the Scorer parameter, but smaller than the inverse inertia wave number, the atmospheric perturbation is a hydrostatic gravity wave with a vertical wave number equal to the Scorer parameter. When the width of the rough patch is comparable to the inverse of the Scorer parameter, the atmospheric perturbation is a propagating lee wave with a vertical wave number equal to the Scorer parameter. When the ambient flow is strong over a small rough patch, the flow is irrotational. The same limitations, inherent to the linear gravity waves excited by the forcing in the atmosphere (e.g., mountain waves, gravity waves initiated by convection, etc.), apply to the mesoscale perturbation induced by a rough patch. GRA

N92-19101# Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
LINEAR IMPACT OF THERMAL INHOMOGENEITIES ON MESOSCALE ATMOSPHERIC FLOW WITH ZERO SYNOPTIC WIND
G. A. Dalu, R. A. Pielke, R. Avissar, G. Kallos, and M. Baldi 15 Jul. 1991 22 p
(Contract N00014-88-K-0029; NSF ATM-89-15265)
(AD-A244147) Avail: NTIS HC/MF A03 CSCL 04/2

This paper presents an analytical evaluation of the perturbations to mesoscale atmospheric flows induced by thermal inhomogeneities in the convective boundary layer. The time evolution of these perturbations is studied as a function of the intensity and of the horizontal and vertical scales of the diabatic forcing. The problem is approached using Laplace transform theory for the time behavior and Green function theory for the spatial structure. Results show that the growth of the atmospheric perturbations closely follows the growth of the convective boundary layer; the transient being characterized by a number of inertia-gravity oscillations of decreasing intensity. The vertical scale is determined by the depth of the convective boundary layer, and the horizontal scale is determined by the local Rossby deformation radius. Sinusoidally periodic thermal forcing induce periodic atmospheric cells of the same horizontal scale. The intensity of mesoscale cells increases for increasing values of the wave number, reaches its maximum value when the wavelength of the forcing is of the order of the local Rossby radius, and then decreases as the wavelength of the forcing decreases. However, because of the destructive interference between mesoscale cells, the intensity of the vertical velocity is only a weak function of the wave numbers, for large wave numbers. Periodic square wave surface thermal inhomogeneities are more effective that sinusoidal waves in generating mesoscale cells, i.e., the intensity of the flow is generally stronger. GRA

N92-19195# Colorado State Univ., Fort Collins.
OPERATING RANGES OF METEOROLOGICAL WIND TUNNELS FOR THE SIMULATION OF CONVECTIVE BOUNDARY LAYER PHENOMENA
Robert N. Meroney and William H. Melbourne 10 Dec. 1991 37 p
(Contract N00014-88-K-0029)
(AD-A244153; CEP90-91-RNM-WNM-11) Avail: NTIS HC/MF A03 CSCL 04/2

The operating ranges of meteorological wind tunnels for convective boundary layer (CBL) simulation are defined in this paper on a review of the theoretical and practical limitations of the flow phenomena and the facilities available. Wind tunnel operating ranges are limited by the dimensions of the simulated circulations and of the tunnel itself, the tunnel flow speed and turbulence processes, and the characteristics of the measurement instrumentation. When it is desired to simulate both the convective boundary layer and the behavior of other flows imbedded within the boundary layer, such as power plant plume rise and dispersion, then additional constraints exist on the fluid modeling process. The capabilities of meteorological wind tunnels can also be extended through the judicious use of boundary and side wall flow controls. GRA

N92-19251# International Meteorological Inst., Stockholm (Sweden). Arrhenius Lab.
[ACTIVITIES REPORT OF THE INTERNATIONAL METEOROLOGICAL INSTITUTE IN STOCKHOLM (SWEDEN)] Annual Report, Jul. 1990 - Jun. 1991
Aug. 1991 77 p
(ISSN-0349-0068; ETN-92-90725) Avail: NTIS HC/MF A05

International collaborative activities, including participation in the Intergovernmental Geosphere-Biosphere Program (OGBP) and the European Chemistry Program (EUROTRAC), are outlined. Research work organized in the sections of dynamic meteorology, chemical meteorology, atmospheric physics, and atmospheric aerosol science is described. The most important function of the institute is to provide opportunites for foreign scientists to work in collaboration for varying periods of time. These visits by scientists are detailed. ESA

N92-19264# Los Alamos National Lab., NM.
LOS ALAMOS CLIMATOLOGY
B. M. Bowen May 1990 254 p
(Contract W-7405-eng-36)
(DE90-011765; LA-11735-MS) Avail: NTIS HC/MF A12

This report was written for a wide audience of readers, from engineers and scientists to individuals just waiting to know about Los Alamos weather. For this reason, and because English units are still the standard in National Oceanic and Atmospheric Administration (NOAA) reporting and publications, familiar English units are primarily used in this report. In most tables and graphs, data are presented in English units, such as degrees Fahrenheit (degree F), inches, and miles per hour (mph). However, metric units, such as degrees Celsius (centigrade) (degree C), centimeters (cm), and meters per second (m/s), are also displayed on second ordinates of most graphs. Only metric units are given for some variables, such as insolation and atmospheric density. In the sections on turbulence and wind persistence, wind speed is given in meters per second because this unit is standard in dispersion meteorology. DOE

N92-19291# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Wolfkenphysik.
A DOCUMENTATION OF ICING RELEVANT CLOUD PHYSICAL PARAMETERS ON HORIZONTAL SOUNDING OF STRATIFORM CLOUDS
Hans-Eberhard Hoffmann and Johann Demmel Apr. 1990 135 p In GERMAN; ENGLISH summary
(DLR-Mitt-91-07; ISSN-0939-298X; ETN-92-90728) Avail: NTIS HC/MF A07; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 29.50 DM

Thirty five horizontal soundings over southern Germany, on flight paths between 20 and 90 km were arranged, according to the type of clouds in relation to high pressure areas, cold and warm fronts, from west to north. In a high pressure area, on a flight path of 40 km and in a constant distance from the cloud base, the Total Water Content (TWC) fluctuated between 0.30 and 0.52 g/cu m. On all the horizontal soudings, the Median Volume Diameter (MVD) had small values between 17 and 25 microns. In a west to north flow, TWC values up to 0.87 g/cu m, and high MVD values were measured. A relation between the quantities of TWC and MVD could not be found. ESA

N92-19299 Royal Netherlands Meteorological Inst., De Bilt. Afdel. Klimatologische Dienst.
THE AIR TEMPERATURE OVER WEST-AMELAND (NETHERLANDS) [DE LUCHTTEMPERATUUR OP WEST-AMELAND]
F. Ynsen 1991 46 p In DUTCH
(KNMI-TR-132; ISSN-0169-1708; ETN-92-91033) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

Time series of temperature observations on the Wadden island West-Ameland were analyzed. The data processing and prediction of the different partial measuring series are explained. Some aspects of the thermal climate over Ameland are discussed. Sea water temperature and air temperature are compared, and local temperature differences and extreme temperature are treated. The effect of the presence of dunes on the Wadden islands on the air temperature were examined. ESA

N92-19302# Alaska Univ., Fairbanks. Geophysical Inst.
NUMERICAL MODELING AND PARAMETERIZATION OF GRAVITY WAVE PROCESSES AND EFFECTS IN THE ATMOSPHERE Final Report, 12 Nov. 1990 - 11 Nov. 1991
David C. Fritts 11 Nov. 1991 4 p

(Grant AF-AFOSR-0026-91; AF Proj. 2310)
(AD-A244175; AFOSR-91-0947TR) Avail: NTIS HC/MF A01 CSCL 04/2

A numerical modeling effort was started which is now providing high-resolution 2-d simulations of compressible nonlinear gravity wave dynamics using a state-of-the-art pseudo-spectral code. These results are a substantial improvement over previous efforts to address the fundamentals of gravity wave breaking, spectral evolution, and momentum and energy transports in the middle atmosphere. GRA

N92-19303# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SEPARATION OF CLOUD/NO-CLOUD REGIONS IN SATELLITE IMAGERY USING A VARIATION OF HIERARCHICAL CLUSTERING ANALYSIS M.S. Thesis
Charles J. Martin, Jr. Dec. 1991 97 p
(AD-A244177; AFIT/GSO/ENS/91D-12) Avail: NTIS HC/MF A05 CSCL 08/2

This study investigated the usefulness of personal computer-based software applying hierarchical clustering theory to try to separate cloud covered regions from clear regions using Automated Picture Transmission imagery from the NOAA's Television Infrared Observation Satellite. The algorithms were developed in Turbo Pascal, Version 6, and are part of the Training Software Image Processing program developed by a professor at the Air Force Institute of Technology. The goal of the project was to see if hierarchical clustering could provide better separation of cloud/no-cloud regions than an existing technique, histogram thresholding, while running on a personal computer. Results of the research indicated that it was possible to use a centroid based clustering algorithm to separate cloud covered regions from clear regions in APT imagery. Seed points were used to start the clustering process. The cloud seed point was chosen to be the brightest pixel in the clustering area. Typical results showed that the automated clustering approach provided results within 15 to 20 pct. of those obtained from the histogram method. GRA

N92-19401# Coast Guard Academy, New London, CT.
EVALUATION OF THE LEVITUS SEA SURFACE CURRENT CLIMATOLOGY FOR USE IN COAST GUARD COMPUTER ASSISTED SEARCH PLANNING Final Report, 10 Jan. - 1 Oct. 1991
B. E. Viekman and T. L. Jordan Aug. 1991 59 p
(PB92-115906; USCGA-5/91) Avail: NTIS HC/MF A04 CSCL 04B

The Levitus Sea Surface Current Climatology, which is derived from ship drift data, is compared to data from satellite-tracked drifting buoys and to other climatologies to evaluate its usefulness for Coast Guard Computer Assisted Search Planning (CASP). Surface drifter information from the eastern Pacific was analyzed to give mean current components. The mean difference between the drifter data and the Levitus file was found to be generally less than 5 cm/sec. Areas of surface currents much stronger than climatology were related to upwelling filaments off the California Coast. Author

N92-19442 Royal Netherlands Meteorological Inst., De Bilt. Div. of Dynamic Meteorology.
TECHNICAL DESCRIPTION LAM AND OI: LIMITED AREA MODEL AND OPTIMUM INTERPOLATION ANALYSIS
W. C. deRooy and L. M. Hafkenscheid 1991 73 p
(KNMI-TR-134; ISSN-0169-1708; ETN-92-91035) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

The FMLAM (Fine Mesh Limited Area Model) is a numerical weather prediction model for the intermediate range (6 to 24 hours). The (FM)LAM originated from the limited area version of the ECMWF (European Center for Medium range Weather Forecast) grid point model. For the analysis LAM uses Optimum Interpolation (OI). The initalization uses a bounded derivative method. The technical description of the software needed to run the LAM system, that is, the OI analysis, initialization and LAM forecastmodel is presented. It is entended for use by programmers and scientists in charge of the maintenance and administration of the LAM/OI system. ESA

N92-19609*# Colorado State Univ., Fort Collins.
NONLINEAR INFLUENCE OF MESOSCALE LANDUSE ON WEATHER AND CLIMATE
May 1991 44 p Revised
(Contracts NAG5-910; N00014-88-K-0029; DE-FG02-90ER-60932; NSF ATM-89-15265; NSF BSR-88-05390)
(NASA-CR-190028; NAS 1.26:190028; AD-A244254) Avail: NTIS HC/MF A03 CSCL 04/2

This paper demonstrates that the influence on the atmosphere of mesoscale landscape spatial variability must be parameterized (or explicitly modeled) in larger scale atmospheric model simulations (including general circulation models). The mesoscale fluxes of heat which result from this variability are shown to be of the same order of magnitude and with a different vertical structure than found for the turbulent fluxes. These conclusions are based on experiments in which no phase changes of water were permitted. When, for example, cumulus clouds organized in response to the landscape pattern develop, the mesoscale influence on larger scale climate is likely to be even more important. To parameterize surface thermal inhomogeneities, the influence of landscape must be evaluated using spectral analysis or an equivalent procedure. For horizontal scales much less than the local Rossby radius, the surface heat fluxes over the different land surfaces can be proportionately summed and an average grid-area value used . Moisture fluxes can probably be represented in the same fashion as for heat fluxes. For larger scale spatial variability, however, the mesoscale fluxes must also be included as shown in this paper. While the linear effect could be parameterized where the spectral analysis is used to fractionally weight the contributions of the different spatial scales, the complete vertical mesoscale heat flux requires the incorporation of nonlinear advective effects. GRA

N92-19614 Saint Louis Univ., MO.
SOME PHYSICAL PROCESSES THAT GOVERN INVERSION AND ANALYTICALLY MODELLED CONVECTION OVER THE ARABIAN SEA Ph.D. Thesis
Ahmet Aksakal 1991 204 p
Avail: Univ. Microfilms Order No. DA9130971

The Arabian Sea troposphere during a summer monsoon season is characterized by convection. While deep, well organized, banded convection is observed over the eastern Arabian Sea, shallow convection capped by an inversion is present over the western Arabian Sea. Observations indicate that this inversion layer rises from the western to the eastern Arabian Sea during the monsoon onset and post-onset periods. Moderately intense convection tends to appear wherever this inversion layer is lifted. The main goal of the research is to investigate the physical processes associated with the growth, maintenance, and dissolution of this inversion. The processes that maintain the inversion are warm air advection from Saudi Arabia, and subsiding air from Iran. The process that weakens an inversion is radiative cooling from a cloud top. The processes that promote convection include sensible warming from the sea surface, and latent heat release due to cumulus clouds. A 33-level analytical model of convection uses a linear system of elastic perturbation equations to determine the solutions such as growth rate, phase speed, and orientation of the most unstable mode. A one-dimensional cloud model is employed to determine the vertical distribution of latent heating. A simple bulk aerodynamic formula is applied to evaluate the surface heat fluxes. The stability indices are computed to evaluate the stratification over the Arabian Sea. Finally, the LOWTRAN-7 computer code is engaged to estimate the radiative cooling rates at the cloud top. Results indicate that moderately deep convection is favored in the west during the pre-onset with intensely deep convection in the east during the onset and post-onset phases. The warm air advection from the Saudi Arabian Desert is associated with the low level strong westerly flow during the onset and post-onset phases. Computed vertical velocities revealed ascent over the western and central Arabian Seas during the pre-onset

phase and descent causing an inversion over the western Arabian Sea during the onset and post-onset phases. Stationary transverse and stationary longitudinal modes are favored for the central and eastern Arabian Sea, respectively, during the entire monsoon. The most unstable mode for the deepest convection is found to be stationary longitudinal. Dissert. Abstr.

N92-19648# Meteorological Satellite Center, Tokyo (Japan).
METEOROLOGICAL SATELLITE CENTER TECHNICAL NOTE NO. 20, 1990
Mar. 1990 97 p In ENGLISH and JAPANESE Original contains color illustrations
(MSC-TN-20; ISSN-0388-9653) Avail: NTIS HC/MF A05

A collection of papers are presented which were of interest to the MSC. Some representative titles are as follows: a location algorithm of ARGOS data collection platform; evaluation and improvement of the accuracy of sea surface temperature derived from the operational processing of TOVS data; on enhancement displaying of GMS image; accuracy of the satellite-derived index of precipitation intensity and its representative characteristics; revised height assignment for high-level cloud motion winds derived from satellite imagery; and improvement of telemetry watching function. For individual titles, see N92-19649 through N92-19654.

N92-19649# Meteorological Satellite Center, Tokyo (Japan).
A LOCATION ALGORITHM OF ARGOS DATA COLLECTION PLATFORM **c61**
Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 1-9 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

A location algorithm for ARGOS Data Collection Platform (DCP) was developed. DCP messages extracted from High Resolution Picture Transmission (HRPT) data included several sets of signal-reception time and Doppler shifted frequency. Least-squares method was applied to these data to locate the DCP. Since two numerical solutions for one DCP location were usually obtained, a true position must be determined by comparison with the previously obtained DCP location. Results were validated with ancillary parameters such as iteration times, distance between obtained pair positions, residual of received frequency in least-squares computation, the number of messages, etc. In the case of fixed platforms, it is shown that the position derived from only well-checked data has the RMS accuracy of 3 km. Derived positions and velocities of floating buoys give valuable information of ocean current in the data sparce region. Author

N92-19650# Meteorological Satellite Center, Tokyo (Japan).
EVALUATION AND IMPROVEMENT OF THE ACCURACY OF SEA SURFACE TEMPERATURE DERIVED FROM THE OPERATIONAL PROCESSING OF TOVS DATA **c48**
Yoshiaki Takeuchi and Yoshito Yoshizaki *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 11-21 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

The accuracy of Tiros Operational Vertical Sounder (TOVS) sea surface temperature products derived for TOVS data at MSC is estimated. It is found that large mean and root mean square errors at some areas are related to persistent error due to unsuitable objective analysis. To improve the accuracy of TOVS SST in regression, three approaches are studied: (1) the optimization of the number of channels for regression; (2) the quality check of classification data base; and (3) the change of scan-angle correction scheme. The results indicate that an increase or decrease in the number of channels used in regression does not have an effective impact on the accuracy, and that well-checked classification data base induce the improvement of the accuracy at the cost of the number of retrieved sea surface temperature. Author

N92-19651# Meteorological Satellite Center, Tokyo (Japan).
ON ENHANCEMENT DISPLAYING OF GMS IMAGE **c61**
Tomoyuki Harada *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 23-32 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

The visual enhancement technique in displaying Geostationary Meteorological Satellite (GMS) image data using a man-machine interactive computer system at the MSC is developed. There are three enhancement techniques: to enhance the observed brightness temperature with the gray density; to enhance with pseudocolor; and to enhance with stereographic presentation. These techniques are introduced to the routine operation for determination of the cloud system center of tropical cyclone as from 1987 typhoon season. Author

N92-19652# Meteorological Satellite Center, Tokyo (Japan).
ACCURACY OF THE SATELLITE-DERIVED INDEX OF PRECIPITATION INTENSITY AND ITS REPRESENTATIVE CHARACTERISTICS
Yoshiyuki Abe, Iwao Nishimori, Hajime Senda, and Takao Imaizumi *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 39-60 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

The satellite-derived index of precipitation intensity (SI) is the estimated value of precipitation intensity using satellite imagery data, and was produced operationally since 1 March 1989. The following three subjects were studied and clarified: (1) accuracy of the SI from June to September in 1989: (a) SI obtained by bi-spectrum (VIS & IR) method provides better accuracy than the one by monospectrum (IR) method, (b) accuracy of the SI depends significantly on the scale and type of disturbances, (c) high accuracy can be expected when Look Up Table (LUT) is applied to the same type of disturbances with a short time interval after the calculation of LUT, and (d) accuracy of the SI decreases when LUT has not been updated for more than several hours; (2) representative characteristics of the SI obtained by IR method: (a) for an extratropical cyclone, the accuracy is generally reasonable, (b) for a typhoon, IR parameters (the mean and the deviation of T sub BB within 200 x 200 km box) does not provide reasonable accuracy because of multilayer cloud structure, and (c) the accuracy is generally reasonable when convective clouds are in the development stage; and (3) remaining issues for future improvement. Author

N92-19653# Meteorological Satellite Center, Tokyo (Japan).
REVISED HEIGHT ASSIGNMENT FOR HIGH-LEVEL CLOUD MOTION WINDS DERIVED FROM SATELLITE IMAGERY
Keiji Doi, Hiroyuki Uchida, and Shigenori Naito *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 61-73 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

In order to improve the accuracy of high level cloud motion wind (CMW) vectors derived from Geostationary Meteorological Satellite (GMS) imagery, two kinds of height assignment methods are examined. One is to calculate height for each tracer cloud using mean T sub BB of pixels above 400 mb. The height by means of this method is called Cloud Height by Temperature (CHT). The other is to revise the height assignment table currently in use in routine operations. The revised height table is statistically determined in every tens of degrees of latitudinal belt zones for every month, using vertical profiles of mean vector difference between CMW and RAWIN sonde data. The height from the revised table is called Wind Height from Table 90 (WHT90), and also the height from the old one is called WHT80. The results are as follows: the accuracy of CMW vectors both at CHT and at WHT90 is better than at WHT80; at CHT, CMW vectors are less accurate than at WHT80 where CMW vectors are in 10 deg N zone and in the equatorial zone and their speed are greater than 40 m/s; and some vectors at CHT have less accuracy than at WHT80 because of height estimation error caused by ambiguity of cloud emissivity. Author

N92-19654# Meteorological Satellite Center, Tokyo (Japan).
IMPROVEMENT OF TELEMETRY WATCHING FUNCTION c17
Shigeto Miura *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 85-97 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

Command and Data Acquisition Station (CDAS) renewed the ground communication system in 1987. The new communication system began working in April 1988. After several months of working and finding some problems concerning telemetry watch, the watch screen of the control console was improved as follows: abbreviation of telemetry names were unified; figures of voltage and current, etc. were unified; and the order of abbreviated telemetry names were unified with subsystems. This improvement was done by renewing data base of telemetry watch systems.
Author

N92-19665# Meteorological Satellite Center, Tokyo (Japan).
METEOROLOGICAL SATELLITE CENTER TECHNICAL NOTE, NO. 22, 1991
Mar. 1991 63 p In ENGLISH and JAPANESE Original contains color illustrations
(MSC-TN-22; ISSN-0388-9653) Avail: NTIS HC/MF A04

Topics of interest to the Meteorological Satellite Center are presented. Some representative titles are as follows: accuracy improvement of the satellite-derived index of precipitation intensity; on the relation between cumulus cloud lines and surface shear lines; analysis tool of GMS image on a work station; and a newly-developed technique of image mapping - distortion data determination based on the Earth edge detection from infrared half disc image. For individual titles, see N92-19666 through N92-19669.

N92-19666# Meteorological Satellite Center, Tokyo (Japan).
ACCURACY IMPROVEMENT OF THE SATELLITE-DERIVED INDEX OF PRECIPITATION INTENSITY
Yoshiyuki Abe, Iwao Nishimori, Yuzo Yotsuya, and Teiichi Sukawa *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 Mar. 1991 p 1-29 In JAPANESE; ENGLISH summary (For primary document see N92-19665 10-47)
Avail: NTIS HC/MF A04

The Satellite-derived Index of Precipitation Intensity (SI) was produced operationally since 1 March 1989. The following was clarified and studied to improve the SI accuracy: (1) operated matters for improvement: (a) seasonal threshold values of radar beam height for radar echo composition were established as 4000 m for warm and cold season, (b) all digital radar data in Japan were composed, (c) Look Up Table (LUT) data (regression coefficients, magnification rate, bias, threshold TBB values) for the IR spectrum used in nighttime were calculated, and (d) constants for representative characteristics conversion (magnification rate, bias) were calculated by using the 1 percent order value in radar intensity data; (2) monthly and hourly accuracy of the SI from Aug. to Dec. 1990: (a) mean correlation coefficient between radar intensity data and SI acquired by using the bi-spectrum method was 0.69 for all cases and 0.76 for cases only immediately after LUT data was updated, and (b) the SI acquired by using the bi-spectrum method provides better accuracy at midday than at early morning or evening; and (3) matters for future improvement: (a) new algorithm, (b) method using the LUT data, and (c) seasonal threshold TBB values for calculation of the LUT data.
Author

N92-19667# Meteorological Satellite Center, Tokyo (Japan).
ON THE RELATION BETWEEN CUMULUS CLOUD LINES AND SURFACE SHEAR LINES
Fumio Ueda *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 Mar. 1991 p 31-39 In JAPANESE; ENGLISH summary (For primary document see N92-19665 10-47)
Avail: NTIS HC/MF A04

The relationship between cumulus cloud lines and surface shear lines were studied. A surface shear line is connected to a Low Altitude Wind Shear (LAWS). LAWS is a phenomenon that affects the aircraft just on landing or takeoff. From an aviational point of view, the relationship between LAWS and cumulus cloud lines was to be studied, but because of insufficiency of the observation report of LAWS, the relation between shear lines and cumulus cloud lines was studied. The findings were as follows: (1) cloud lines can be classified into moving and stationary and into off the east and off the south coasts; (2) stationary cloud line east of Choshi does not correspond to surface shear line; (3) stationary cloud line off the south coast does not correspond to surface shear line that continues to inner land; (4) moving cloud line off the east coast corresponds to surface shear line - this cloud line is formed as a part of a comma-shaped cloud; and (5) cloud line moving off the south coast eastward with the cold front band does not correspond to surface shear line directly.
Author

N92-19668# Meteorological Satellite Center, Tokyo (Japan).
ANALYSIS TOOL OF GMS IMAGE ON WORK STATION
Ryota Ohama and Shigenori Naito *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 Mar. 1991 p 41-52 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N92-19665 10-47)
Avail: NTIS HC/MF A04

An neph-analysis tool was developed on a work station. An analyst is able to analyze more detailed meso-scale phenomena, which will be the significant item of the next weather forecast service, using superimposition of geostationary meteorological satellite image and grid point value data with the aid of this software tool. Also, easy operation and applicability are performed by adapting X-window V.II system for image processing. The process of this tool is described and some typical examples of superimposition are shown.
Author

N92-19669# Meteorological Satellite Center, Tokyo (Japan).
A NEWLY-DEVELOPED TECHNIQUE OF IMAGE MAPPING: DISTORTION DATA DETERMINATION BASED ON THE EARTH EDGE DETECTION FROM INFRARED HALF DISC IMAGE
Seiichiro Kigawa *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 Mar. 1991 p 53-63 In JAPANESE; ENGLISH summary (For primary document see N92-19665 10-47)
Avail: NTIS HC/MF A04

Image mapping makes each pixel of VISSR image data correspond to its position on the Earth. VISSR image data is absolutely necessary for use in image mapping. In order to improve the accuracy of the image mapping, MSC developed a fine tuning technique, called distortion data determination, based on the earth edge detection from infrared full disc image (Takahashi, 1981). This technique, however, can only be applied to full disc images and therefore its correction can not be reflected to WEFAX (Weather Facsimile Experiment) because of the broadcast time schedule. Moreover, the accuracy of the image mapping estimated from landmark matching data shows a seasonal variation (Kigawa, 1990). To solve these problems, a fine tuning technique of image mapping using earth edge data of the northern hemisphere was developed. The accuracy of the newly developed technique estimated from landmark matching data is 140 micron radian and less. It will be possible to revise this technique with visible earth edge data.
Author

N92-19674# National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
EQUATORIAL PACIFIC OCEAN CLIMATE STUDIES (EPOCS) Progress Report, Jun. 1991
Jun. 1991 100 p
(PB92-114628; Contrib-1321) Avail: NTIS HC/MF A05 CSCL 04B

The following topics are covered: theoretical model studies of oceans and atmosphere (ocean general circulation model simulation studies, operational ocean modeling, data assimilation studies, studies with atmospheric models, simple coupled models, and coupled general circulation models); meteorological studies

(the global southern oscillation signal, operational surface winds and fluxes, observational studies of tropical wind, and intraseasonal variability); and oceanographic studies (equatorial processes and regional circulation). GRA

N92-19693 Washington Univ., Saint Louis, MO.
MESOSCALE ANALYSIS OF AN INTENSE MID-LATITUDE SQUALL-LINE SYSTEM Ph.D. Thesis
Michael Irwin Biggerstaff 1991 227 p
Avail: Univ. Microfilms Order No. DA9131609

The kinematic structure of the mature phase of a mid-latitude squall-line system with a leading-line trailing stratiform-precipitation structure was examined using a unique set of composite data analyses. The broad-scale aspects of the storm system were determined from a composite of high-frequency rawinsonde, profiler, and surface mesonetwork data combined with several dual-Doppler analyses in a common framework attached to the moving storm. A higher-resolution, but spatially more limited, composite was constructed using eleven dual-Doppler analyses which provided detailed wind and precipitation information over the entire breadth of the northern half of the storm. Analysis from these two data sets revealed several aspects of the structure of squall-line systems that have not been documented previously. A deep layer of subsidence consisting of two separate, but vertically aligned, downdrafts driven by different mechanisms was found over the mid-to-low level radar-reflectivity minimum in the transition zone. Based on an analysis of the individual downdrafts observed in the near-instantaneous dual-Doppler syntheses, the upper-level and lower-level transition zone downdrafts were found to be the averaged effect of the convective drafts in dissipating convective cells that were moving rearward relative to the front edge of the storm. The structure of the individual upper-level downdrafts suggested that they were a combination of dynamically forced gravity waves excited by the interaction of the penetrative updrafts with the stable ambient flow and other pressure forces associated with the rearward moving dissipating convective cells. Hydrometeor trajectories through the transition zone revealed that the hydrometeors in the reflectivity minimum were likely unaffected by the upper-level transition-zone downdraft. However, the mid-to-low level subsidence was important in the development of the reflectivity minimum through the sublimation of small ice crystals in the transition zone that lead to less aggregation in a shallow layer just above the melting level over the transition zone than over the enhanced portions of the stratiform precipitation farther back. A banded vertical-vorticity structure, maintained by the tilting of across-line horizontal vorticity by gradients in the mesoscale vertical-motion field, was found at mid-levels in the trailing stratiform region. Dissert. Abstr.

N92-19768*# Wisconsin Univ., Madison. Space Science and Engineering Center.
ANTECEDENT PRECIPITATION INDEX DETERMINED FROM CST ESTIMATES OF RAINFALL Final Report, 15 Nov. 1990 - 15 Feb. 1992
David W. Martin Feb. 1992 44 p
(Grant NAG5-1478)
(NASA-CR-189908; NAS 1.26:189908; UWM-144-BY14) Avail: NTIS HC/MF A03 CSCL 04B

This paper deals with an experimental calculation of a satellite-based antecedent precipitation index (API). The index is also derived from daily rain images produced from infrared images using an improved version of GSFC's Convective/Stratiform Technique (CST). API is a measure of soil moisture, and is based on the notion that the amount of moisture in the soil at a given time is related to precipitation at earlier times. Four different CST programs as well as the Geostationary Operational Enviroment Satellite (GOES) Precipitation Index developed by Arkin in 1979 are compared to experimental results, for the Mississippi Valley during the month of July. Rain images are shown for the best CST code and the ARK program. Comparisons are made as to the accuracy and detail of the results for the two codes. This project demonstrates the feasibility of running the CST on a synoptic scale. The Mississippi Valley case is well suited for testing the feasibility of monitoring soil moisture by means of CST. Preliminary comparisons of CST and ARK indicate significant differences in estimates of rain amount and distribution. H.A.

N92-19802# National Inst. of Standards and Technology, Boulder, CO. Wave Propagation Lab.
USE OF THE SUN UNIX SYSTEM: BEGINNER'S GUIDE
D. C. Welsh Sep. 1991 25 p
(PB92-115880; NOAA-TM-ERL-WPL-208) Avail: NTIS HC/MF A03 CSCL 04B

A guide for the new user on a Sun UNIX computer is presented. A brief history of UNIX is presented. The background concepts of UNIX are presented next for input, output, and the file system. Finally, UNIX commands are presented, grouped by function: directory, file network, and miscellaneous. GRA

N92-19807# Systems Applications International, San Rafael, CA.
DIAGNOSTIC ANALYSIS OF WIND OBSERVATIONS COLLECTED DURING THE SOUTHERN CALIFORNIA AIR QUALITY STUDY Final Report
Sharon G. Douglas, Robert C. Kessler, Christopher A. Emery, and Janice L. Burtt Jun. 1991 350 p
(Contract ARB-A8-133-32)
(PB91-226852; SYSAPP-91/079; ARB-R-91/458) Avail: NTIS HC/MF A15 CSCL 04B

Wind data collected during eight intensive monitoring periods in the 1987 Southern California Air Quality Study (SCAQS) were used to analyze the mesoscale airflow patterns in the South Coast Air Basin (SOCAB). The SCAQS data base contains the most comprehensive set of surface and upper air wind data ever assembled for the SOCAB. The data set represents good spatial and temporal resolution of some mesoscale airflow features. The wind data were analyzed using a diagnostic wind model. The analysis consisted of the generation of hourly, gridded wind fields for the 17 SCAQS intensive study days, analysis of the mesoscale airflow patterns, and the calculation of forward and backward particle trajectories to examine pollutant transport in the SOCAB. Author

N92-19819# Oak Ridge National Lab., TN. Carbon Dioxide Information Analysis Center.
AN UPDATED GLOBAL GRID POINT SURFACE AIR TEMPERATURE ANOMALY DATA SET: 1851-1990
R. J. Sepanski, T. A. Boden, and R. C. Daniels Oct. 1991 5225 p
(Contract DE-AC05-84OR-21400)
(DE92-004582; ORNL/CDIAC-37; NDP-020/R1) Avail: NTIS HC/MF A99

This document presents land-based monthly surface air temperature anomalies (departures from a 1951-1970 reference period mean) on a 5 degree latitude by 10 degree longitude global grid. Monthly surface air temperature anomalies (departures from a 1957-1975 reference period mean) for the Antarctic (grid points from 65 degrees S to 85 degrees S) are presented in a similar way as a separate data set. The data were derived primarily from the World Weather Records and the archives of the United Kingdom Meteorological Office. This long-term record of temperature anomalies may be used in studies addressing possible greenhouse-gas-induced climate changes. To date, the data have been employed in generating regional, hemispheric, and global time series for determining whether recent (i.e., post-1900) warming trends have taken place. This document also presents the monthly mean temperature records for the individual stations that were used to generate the set of gridded anomalies. The periods of record vary by station. Northern Hemisphere station data have been corrected for inhomogeneities, while Southern Hemisphere data are presented in uncorrected form. DOE

N92-19833# National Weather Service, Fort Worth, TX.
PREDICTION OF PULSE-TYPE THUNDERSTORM GUSTS USING VERTICALLY INTEGRATED LIQUID (VIL) WATER CONTENT AND THE CLOUD TOP PENETRATIVE DOWNDRAFT MECHANISM
S. R. Stewart Oct. 1991 24 p
(PB92-101823; NOAA-TM-NWS-SR-136) Avail: NTIS HC/MF A03 CSCL 04B

Operational forecasting of maximum surface wind gusts generated by pulse type thunderstorms has always been a challenge for meteorologists. Oftentimes, it is known that the environment is conducive to the production of strong thunderstorms, but obviously not all of the thunderstorms that develop will generate severe wind gusts at the surface. Through the use of the Cloud Top Penetrative Downdraft Mechanism and the combination of Vertically Integrated Liquid (VIL) water contents and Radio Echo Heights (TOP) obtained from the RADAP II system, a technique has been proposed to assist operational meteorologists in forecasting the gust potential of air-mass (pulse type) thunderstorms in near real-time situations. Author

N92-19867# National Weather Service, Fort Worth, TX.
METEOROLOGY SUPPORT AT THE JOINT WARNING CENTER, GUAM DURING OPERATION DESERT STORM (ODS)
S. R. Stewart Nov. 1991 21 p
(PB92-107572; NOAA-TM-NWS-SR-138) Avail: NTIS HC/MF A03 CSCL 04B

A tropical cyclone and typhoon warning center operated by the Navy Oceanographic Command and located on Guam Island is described. The cyclone forcasting procedures are described, and the forecast track is prepared by using objective forecast aids. Since most of the specific Operation Desert Storm operations remain classified, this paper focuses on the unclassified operations of the Joint Typhoon Warning Center. GRA

N92-19961# National Inst. of Standards and Technology, Gaithersburg, MD.
NIST CALIBRATION SERVICES FOR HUMIDITY MEASUREMENT
A. Wexler, R. W. Hyland, S. Hasegawa, and P. H. Huang Oct. 1991 65 p
(PB92-112499; NISTIR-4677) Avail: NTIS HC/MF A04 CSCL 04B

The National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS), provides a service to government agencies and to the public for the calibration of humidity measuring instruments. Calibrations are performed by subjecting the instrument under test to atmospheres of known moisture content produced by the NBS two-pressure humidity generator. The most accurate calibrations are made with the NBS standard hygrometer, a device based on the gravimetric method. The internal report documents the original work for the NBS standard hygrometer, and for the NBS two-pressure humidity generator. The operations, tests, calibrations of component parts, and sources of errors of the standard hygrometer and the humidity generator are summarized. The random and systematic errors affecting the overall accuracy of the standard hygrometer and the humidity generator are analyzed and shown by tables. GRA

N92-19317*# Wisconsin-Stout Univ., Menomonie. Dept. of Physics.
ALGORITHMS FOR CONTOURS DEPICTING STATIC ELECTRIC FIELDS DURING ADVERSE WEATHER CONDITIONS
John T. Rompala *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 344-376 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-19060# Coastal Engineering Research Center, Vicksburg, MS.
HINDCAST WAVE INFORMATION FOR THE GREAT LAKES: LAKE MICHIGAN Final Report
Jon M. Hubertz, David B. Driver, and Robin D. Reinhard Oct. 1991 504 p
(AD-A243784; CERC-WIS-24) Avail: NTIS HC/MF A22 CSCL 08/8

Thirty-two years of hindcast wind and wave information is summarized for 70 locations along the shoreline of Lake Michigan in four data products: (1) percent occurrence tables; (2) wave rose diagrams; (3) mean and largest wave heights and 32-year statistics tables; and (4) return period tables. The procedures used to produce this information are discussed, and examples of verification against measurements are shown. GRA

N92-19061# Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
DEVELOPMENT AND VERIFICATION OF A 3-DIMENSIONAL NUMERICAL HYDRODYNAMIC, SALINITY, AND TEMPERATURE MODEL OF CHESAPEAKE BAY. VOLUME 1: MAIN TEXT AND APPENDIX D Final Report
B. H. Johnson, R. E. Heath, B. B. Hsieh, K. W. Kim, and H. L. Butler Aug. 1991 193 p
(AD-A243785; WES/TR/HL-91-7-Vol-1) Avail: NTIS HC/MF A09 CSCL 08/8

A time-varying three-dimensional (3-D) numerical hydrodynamic model of Chesapeake Bay has been developed to provide flow fields to a 3-D water quality model of the bay. The water surface, 3-D velocity field, salinity, and temperature are computed. Major physical processes affecting bay circulation and vertical mixing are modeled. A particular feature of the model is the solution of transformed equations on a boundary-fitted grid in the horizontal plane. The 3-D model has been verified through application to six data sets. The first three were about 1 month long each and represented a dry summer condition, a spring runoff, and a fall wind-mixing event. The last three were yearlong simulations for the years of 1984, 1985, and 1986. These years represent a wet, dry, and average freshwater inflow year, respectively. A major storm in November 1985 over the lower portion of the bay resulted in a 200-year flood on the James River and served to demonstrate the ability of the model to simulate extreme events. Results from these applications demonstrate that the model is a good representation of the hydrodynamics of the Chesapeake Bay and its major tributaries. GRA

N92-19062# Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
DEVELOPMENT AND VERIFICATION OF A 3-DIMENSIONAL NUMERICAL HYDRODYNAMIC, SALINITY, AND TEMPERATURE MODEL OF CHESAPEAKE BAY. VOLUME 2: APPENDIXES A THROUGH C Final Report
B. H. Johnson, R. E. Heath, B. B. Hsieh, K. W. Kim, and H. L. Butler Aug. 1991 668 p
(AD-A243786; WES/TR/HL-91-7-Vol-2) Avail: NTIS HC/MF A99 CSCL 08/8

A time-varying three-dimensional (3-D) numerical hydrodynamic model of Chesapeake Bay has been developed to provide flow fields to a 3-D water quality model of the bay. The water surface, 3-D velocity field, salinity, and temperature are computed. Major physical processes affecting bay circulation and vertical mixing are modeled. A particular feature of the model is the solution of transformed equations on a boundary-fitted grid in the horizontal plane. The 3-D model has been verified through application to six data sets. The first three were about 1 month long each and represented a dry summer condition, a spring runoff, and a fall wind-mixing event. The last three were yearlong simulations for

the years of 1984, 1985, and 1986. These years represent a wet, dry, and average freshwater inflow year, respectively. A major storm in November 1985 over the lower portion of the bay resulted in a 200-year flood on the James River and served to demonstrate the ability of the model to simulate extreme events. Results from these applications demonstrate that the model is a good discription of the hydrodynamics of the Chesapeake Bay and its major tributaries. This volume provides the results for 1984, 1985, and 1986. GRA

N92-19215# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PERIODICITIES IN SEA LEVEL CHANGES AT STOCKHOLM
Rajaram Purushottam Kane and Delano Gobbi Aug. 1991 16 p Submitted for publication Sponsored in part by FNDCT Brazil
(INPE-5286-PRE/1691) Avail: NTIS HC/MF A03

The annual mean sea level time series for Stockholm for 1825 to 1984 (160 data points) had a large long term negative (almost linear, only slightly quadratic) trend. After correcting for the same, the detrended series was subjected to Maximum Entropy Spectral Analysis. Choosing selected periodicities for further Multiple Regression Analysis, series for the first 80 yrs showed periodicities T = 2.40, 5.0, 6.1, 13.5, 14.8, 32 yrs, significant at a 2 sigma level. The three largest peaks had amplitudes of approx. 2.5 to 3.0 + or - 0.8 cm. The latter 80 yrs showed significant periodicities T = 2.05, 2.7, 3.0, 3.6, 4.4, 5.5, 6.3, 7.7, 9.8, 20.5, 33 yrs. The three largest peaks had amplitudes of approx. 2.0 to 2.5 + or - 0.7 cm. The 160 yrs showed significant periodicities T = 2.05, 2.9, 3.2, 4.5, 4.9, 5.6, 6.4, 7.8, 11.0, 13.7, 14.8, 29, 43 yrs. The three largest peaks had amplitudes of approx. 1.6 to 1.9 + or - 0.6 cm. All these peaks explained variance of only approx. 30 pct. or less, indicating a large random component of approx. 70 pct. Peaks at T = 11 yrs (sunspot cycle) or T = 18.6 yrs (lunar nodal term) were either absent or very weak. Some periodicities seem to resemble those seen in the Southern Oscillation index. Author

N92-19240# Naval Postgraduate School, Monterey, CA.
A NUMERICAL STUDY OF THE EFFECTS OF WIND FORCING ON THE CHILEAN CURRENT SYSTEM M.S. Thesis
Jeffrey L. Bacon Mar. 1991 78 p
(AD-A243794; NPS-OC-91-001) Avail: NTIS HC/MF A05
CSCL 08/3

A high-resolution, multi-level, primitive equation ocean model is used to examine the response of an idealized, flat-bottomed, eastern boundary oceanic regime on a betaplane to both steady and daily varying climatological wind forcing. The area of study is a coastal region within the Chile Current System from 22 S to 34 S. When steady wind forcing is used, an equatorward surface current and poleward flowing undercurrent develop. Eddies are also generated, with initial information in the poleward end of the domain. When daily-varying wind forcing is used, there is large spatial variability in the oceanic response. A relatively weak poleward flowing undercurrent appears, first in the poleward of the domain. An equatorward surface current also develops and intensifies during the upwelling season. Eddies are generated and develop farther poleward in the domain than in the first experiment. The eddies are largest in the equatorward end of the domain. The eddy motion is closely tied to seasonal influences, with cyclonic (divergent) eddies traversing towards areas of higher dynamics heights when there are divergent wind fields present, and vice versa. In addition to the currents and eddies, upwelling and cold filaments are evident in both experiments. GRA

N92-19351# Greenhorne and O'Mara, Inc., Greenbelt, MD.
INITIAL STATISTICAL CHARACTERIZATION OF THE VARIABILITY OF COASTAL WINDS AND CURRENTS
Executive Summary Report
C. D. Miller, S. R. Signorini, L. E. Borgman, D. W. Denbo, and C. E. Dorman Apr. 1991 39 p Sponsored in part by Minerals Management Service, Camarillo, CA
(Contract DI-14-12-0001-30384)
(PB91-241083; OCS/MMS-91/0024) Avail: NTIS HC/MF A03; also available in set of 4 reports HC/MF E99 as PB91-241042
CSCL 08C

The purpose of the present study originates with the goal of the U.S. Department of the Interior, Minerals Management Service (MMS) to improve the methodology for evaluating risks associated with spilled oil in the marine environment. To achieve an improvement in risk assessment, the means by which the trajectories of hypothetical oil spills are predicted must be improved. In this regard, the spatial and temporal coverage of observations of currents and winds, alone or in conjunction with numerical models, must be adequate to describe the appropriate wind and current flow patterns. The present study addresses two aspects in the application of statistical techniques to the problem of improving our understanding of current and wind patterns off the U.S. west coast: (1) the characterization of the temporal and spatial variability observable in wind and current records; and (2) the identification of ways to statistically supplement these records and eventually incorporate this variability in the initial and boundary conditions of numerical models. Author

N92-19525 Princeton Univ., NJ.
NUMERICAL STUDIES OF GULF STREAM MEANDERS IN THE SOUTH ATLANTIC BIGHT Ph.D. Thesis
Huijie Xue 1991 194 p
Avail: Univ. Microfilms Order No. DA9135862

Gulf Stream meanders in the South Atlantic Bight were numerically studied by means of stability analyses and numerical simulations. Stability analyses are carried out by solving eigenvalue problems obtained from the linearized primitive equations. The most unstable wave found in the model has a wavelength of 215 km and a phase speed of 39.7 km/day for the cross-section upstream of the Charleston Bump, and it has a wavelength of 225 km and a phase speed of 33.0 km/day for the cross-section downstream of the Charleston Bump. At each cross-section, the flat bottom case is provided to study topographic effects. Baroclinic instability is reduced due to the topography, especially in the area where the bottom slope exceeds the slope of deep isopycnals. Barotropic instability is hardly affected by the topography. The growth rate of the most unstable wave reduces by 30 to 50 percent, and the maximum growth rate shifts towards smaller wavenumbers and higher phase speeds after incorporating the topography. Numerical simulations of the Gulf Stream in the South Atlantic Bight are carried out by using a fully nonlinear, three-dimensional model. The continental slope acts again as a stabilizing factor. Although the growth rate decreases by only 30 percent, this small amount of reduction is crucial to the development of substantial meanders. Perturbations grow rapidly in amplitude and form frontal eddies in the flat bottom case. However, after incorporating the topography, all perturbations move out of the domain before developing into finite amplitude meanders. Meanders can be produced in the model with the topography by perturbing the temperature field at the southern boundary. The presence of the bump provides favorable conditions to release the mean potential energy, but it is not able to excite large meanders upstream and downstream of the bump. Dissert. Abstr.

N92-19527*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
BIO-OPTICAL PROFILE DATA REPORT: SOUTHERN CALIFORNIA BIGHT STUDY (SCB2-29) R/V ROBERT G. SPROUL, 20-25 AUGUST 1988
Donald J. Collins and An Van Tran 15 Dec. 1990 65 p
(NASA-CR-189763; JPL-Publ-90-57; NAS 1.26:189763) Avail: NTIS HC/MF A04 CSCL 08C

Time series measurements of the incident surface downwelling irradiance and vertical profiles of the bio-optical properties of the ocean were studied during the 29th cruise of the Southern California Bight Study (SCBS) during the period of August 20-25, 1988. A summary of these data is presented to permit investigators an overview of the data collected. The data are available in digital form for scientific investigators. Author

N92-19687# Greenhorne and O'Mara, Inc., Greenbelt, MD.
INITIAL STATISTICAL CHARACTERIZATION OF THE VARIABILITY OF COASTAL WINDS AND CURRENTS. VOLUME 2: APPENDICES
C. D. Miller, S. R. Signorini, J. R. Hill, L. E. Borgman, and D. W. Denbo Apr. 1991 615 p Sponsored in part by Minerals Management Service, Camarillo, CA
(Contract DI-14-12-0001-30384)
(PB91-241067; OCS/MMS-91/0020) Avail: NTIS HC/MF A99; also available in set of 4 reports HC/MF E99 as PB91-241042 CSCL 08C

The discussion of the variability contained within the wind and current records is initiated by describing the basic statistics that emerge as a byproduct of the data displays. These consist of composite time series plots of cross-shelf and alongshore velocity components, vector stick plots, and monthly mean and standard deviation. These plots are contained in the appendices. A summary of the zero-order statistics for a select set of field studies and observation sites is presented. The predominant direction of the flow is based on the monthly mean values. The descriptions were arranged to highlight year-to-year changes at the same location. GRA

N92-19688# Greenhorne and O'Mara, Inc., Greenbelt, MD.
INITIAL STATISTICAL CHARACTERIZATION OF THE VARIABILITY OF COASTAL WINDS AND CURRENTS. VOLUME 3: USERS MANUAL
J. R. Hill, W. J. OBrien, C. D. Miller, L. E. Borgman, and D. W. Denbo Apr. 1991 243 p Sponsored in part by Minerals Management Service, Camarillo, CA
(Contract DI-14-12-0001-30384)
(PB91-241075; OCS/MMS-91/0021) Avail: NTIS HC/MF A11; also available in set of 4 reports HC/MF E99 as PB91-241042 CSCL 08C

The overview gives a description of the oceanographic database and statistical analysis software developed for the Minerals Management Service (MMS). It provides information useful to both MMS Management and technical staff addressing the installation, access, and overall capabilities of the database package. References are made to specific sections in the users manual for readers requiring more detailed information. The sections address: (1) the tape and disk products provided as deliverables for the contract; (2) the computer hardware requirements; (3) the structure, interrelationship, and overall functionality of the database; and (4) potential future enhancements to the database and software. GRA

N92-19806# Greenhorne and O'Mara, Inc., Greenbelt, MD.
INITIAL STATISTICAL CHARACTERIZATION OF THE VARIABILITY OF COASTAL WINDS AND CURRENTS, VOLUME 1 Final Report
C. D. Miller, S. R. Signorini, J. R. Hill, L. E. Borgman, and D. W. Denbo Apr. 1991 392 p Sponsored in part by Minerals Management Service, Camarillo, CA
(Contract DI-14-12-0001-30384)
(PB91-241059; OCS/MMS-91/0019) Avail: NTIS HC/MF A17; also available in set of 4 reports HC/MF E99 as PB91-241042 CSCL 08C

The goals of the U.S. Department of the Interior, Minerals Management Service (MMS), to improve the methodology for evaluating risks associated with spilled oil in the marine environment, are discussed. This implies that the forcing mechanisms for the oil transport, wind and current, are sufficiently understood in the sense of being deterministic at some level of accuracy. The spatial and temporal coverage of field data, along or in conjunction with numerical models, must be adequate to describe the detailed wind and current flow patterns. However, oceanographic data are generally sparse, relative to the broad range of time and space scales over which wind and currents are variable, and numerical models of winds and currents only approximate real flow patterns (due to constraints of the physics represented, the finite difference schemes employed, and the limited resolution imposed by available computer power). Author

N92-19813# Woods Hole Oceanographic Inst., MA.
REFINEMENT AND APPLICATION OF A NEW PALEOTEMPERATURE ESTIMATION TECHNIQUE Ph.D. Thesis
E. L. Sikes 1990 129 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge
(Grants NSF OCE-83-08893; NSF ATM-84-14335)
(PB92-112853; WHOI-90-26) Copyright Avail: NTIS HC/MF A07 CSCL 08C

A new sea surface temperature (SST) estimation technique was developed for quantitative paleo studies by calibrating the method for sediments. The technique, known as Uk37, analyzes the unsaturation ratio of C37 methyl alkenones produced by Prymnesiophyceae phytoplankton. Uk37 reflects overlying SST and falls on the regression line for culture and water column samples. This indicates that the equation is suitable for use in converting Uk37 sedimentary values to overlying SST. Methods of storage and sample handling as well as laboratory experiments of carbonate dissolution showed no resolvable effect on Uk37. Initial field results support the dissolution results, but indicate more studies are necessary. Disagreement between methods appears to reflect differing habitats of flora and fauna. GRA

N92-19814# Woods Hole Oceanographic Inst., MA.
MODERN AND GLACIAL THERMOCLINES ALONG THE BAHAMA BANKS Ph.D. Thesis
N. C. Slowey 1990 132 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge
(Grants NSF OCE-88-13307; NSF OCE-88-00693)
(PB92-112838; WHOI-90-49) Copyright Avail: NTIS HC/MF A07 CSCL 08C

Studies of the modern and glacial thermoclines at the Bahama Banks and methods to determine past sea levels are presented. First potential temperature-salinity relationships of waters from the Providence Channels demonstrate the Sargasso Sea origin of deep and thermocline waters. Cross channel section of hydrographic properties suggest aspects of circulation. Next glacial-recent Holocene differences in thermocline temperatures and nutrient concentrations are inferred from foraminifera isotopic composition. These results indicate a direct response of thermocline circulation to changes in glacial ocean-surface climate and bear on the glacial-interglacial vertical redistribution of nutrients and the origin of glacial intermediate-depth waters in the North Atlantic. GRA

N92-19820# Swedish Inst. of Space Physics, Kiruna.
KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 91/4-6, APRIL-JUNE 1991
S. Kirkwood 1991 42 p
(PB92-125616) Avail: NTIS HC/MF A03 CSCL 08C

Kiruna Geophysical Data is a collection of results of ground-based more or less continuous measurements of upper atmosphere variables carried out at the Swedish Institute of Space Physics. The following are included: tables of Apr.-Jun. 1991 geomagnetic K-indices, and all-sky camera; and reproductions for Apr.-Jun. 1991 magnetogram plots and riometer recordings. GRA

N92-19917# Woods Hole Oceanographic Inst., MA.
OBSERVATIONS OF WAVE-MEAN FLOW INTERACTION IN THE PACIFIC EQUATORIAL UNDERCURRENT Ph.D. Thesis
E. C. Brady 1990 221 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge
(Grants NSF OCE-82-14955; NSF OCE-85-04125)
(PB92-112937; WHOI-90-51) Copyright Avail: NTIS HC/MF A10 CSCL 08C

The effect of Tropical Instability Waves (TIW) in the momentum balance and energetics of the Pacific equatorial undercurrent is investigated using velocity and temperature time series from a three-dimensional mooring array at 110 W. TIWs are observed as large oscillations in the meridional velocity records at 110 W with an energy peak at 21 days. The observed westward and upward phase propagation is compared to the mixed Rossby-gravity wave. Large northward-eastward momentum fluxes and southward

temperature fluxes affect the dynamics of the mean undercurrent through the Reynolds stress divergence and the Eliassen-Palm flux divergence. An estimate of the vertical eddy flux of eastward momentum, uw, is inferred using the eddy temperature equation. Using mean hydrographic sections at 150 W and 110 W, a downstream decrease in the Bernoulli function is observed on the equator along potential density surfaces. Since the mean kinetic energy of the undercurrent varies little downstream from 150 W to 110 W, this decrease releases mean available potential energy stored in the east-west sloping thermocline. The time series records show that the TIWs gain kinetic energy from the undercurrent through shear production. The energetics of the mean undercurrent are discussed within the context of these observations. GRA

N92-19919# MBC Applied Environmental Sciences, Inc., Costa Mesa, CA.
PROCEEDINGS OF A WORKSHOP ON SOUTH CALIFORNIA BIGHT PHYSICAL OCEANOGRAPHY
Sep. 1991 175 p Workshop held in La Jolla, CA, 27-29 Nov. 1990 Sponsored in part by Minerals Management Service, Camarillo, CA
(Contract DI-14-12-0001-30327)
(PB92-116011; OCS/MMS-91/0033) Avail: NTIS HC/MF A08 CSCL 08C

The report documents the proceedings of the 'Southern California Bight Physical Oceanography Workshop' held at Scripps Institution of Oceanography (SIO) on November 27-29, 1990 to review the scientific and technical information available to assess the potential impact of oil and gas exploration in the Southern California Bight (SCB), and make recommendations on how to improve that knowledge base to overcome deficiencies noted by the National Research Council (NRC 1989). The workshop was conducted in three parts. Technical experts first gave overviews representing the state of knowledge in different subdisciplines, including atmospheric circulation, shelf and slope circulation, mixing and dispersion, and application of observations. On the second day, workshop attendees were divided up into working groups to recommend a course of action which would enable MMS to effectively predict impact. On the third day, all the group recommendations were coordinated into a number of workshop recommendations. Author

N92-19921# Woods Hole Oceanographic Inst., MA.
VARIATIONS IN STRUCTURE AND TECTONICS ALONG THE MID-ATLANTIC RIDGE, 23 DEG N AND 26 DEG N Ph.D. Thesis
L. S. L. Kong 1990 343 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge
(Grant NSF EAR-84-07789)
(PB92-112796; WHOI-90-28) Copyright Avail: NTIS HC/MF A15 CSCL 08C

The variation in the depth and width of the median valley along the Mid-Atlantic Ridge (MAR) suggests that the formation of ocean crust at slow spreading centers is not a simple two-dimensional process in which accretion occurs uniformly both along the axis and with time. Rather, it was proposed that the ridge be divided into a number of distinct spreading cells, or segments. The thesis investigates the segmentation model by studying the variability in the structure and tectonics with the cells along the MAR. The observations are based on the interpretation of side scan sonar data and multibeam bathymetry at 23 N, the hypocentral distribution and source characteristics of microearthquakes near an active hydrothermal field at 26 N, the two-dimensional P wave crustal structure beneath the median valley as determined from travel time and waveform modelling, the tomographic inversion of travel time residuals at 26 N, and the measurement of P and S wave travel time delays from teleseismically-located ridge earthquakes near 26 N. The results support the segmentation model in which accretion varies along the ridge, evolving as independent spreading cells, with different portions of the ridge system being in different stages of volcanic and tectonic evolution. GRA

N92-19650# Meteorological Satellite Center, Tokyo (Japan).
EVALUATION AND IMPROVEMENT OF THE ACCURACY OF SEA SURFACE TEMPERATURE DERIVED FROM THE OPERATIONAL PROCESSING OF TOVS DATA
Yoshiaki Takeuchi and Yoshito Yoshizaki *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 11-21 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

51 LIFE SCIENCES (GENERAL)

N92-19636# Missouri Univ., Columbia.
EFFECTS OF LIQUID DESICCANTS ON AIRBORNE MICROORGANISMS: LABORATORY SET UP, PROCEDURE DEVELOPMENT, AND PRELIMINARY MEASUREMENTS Ph.D. Thesis
K. A. Robertson-Demers Aug. 1991 100 p
(Contract DE-AC05-76OR-00033)
(DE92-004749; DOE/OR-00033/T454) Avail: NTIS HC/MF A05

Airborne microorganisms are present in all indoor environments including homes, office, schools, and hospitals. These organisms have been found to be responsible for many acute diseases, infections, and allergies. The direct consequences of illnesses and human discomfort is loss of productivity and increased medical costs. Therefore, the removal of these organisms from indoor environments is of great interest. One method that has great potential for removing airborne microorganisms is a liquid desiccant based air conditioning system for removing airborne microorganisms. Various liquid desiccants including lithium chloride, calcium chloride, and triethylene glycol have been reported to have several advantages such as air disinfectant properties, capability to control humidity and temperature, and removal of cell fragments as well as living cells. However, very few systematic studies are available in the literature. Therefore, this research had four objectives: (1) to carry out an extensive literature survey regarding sources of microorganisms, sampling methods, and present methods of removal; (2) to set up a microbiology laboratory and to develop an in vitro exposure procedure for the purpose of systematically studying effects of desiccants on airborne microorganisms; (3) to perform in vitro studies to assess desiccant effectiveness; and (4) to determine relative efficiencies of two airborne sampling devices. DOE

N92-19911# Corvallis Environmental Research Lab., OR.
TWO DIFFERENT APPROACHES FOR CONTROL AND MEASUREMENT OF PLANT FUNCTIONS IN CLOSED ENVIRONMENTAL CHAMBERS
C. McFarlane, T. Pfleeger, H. D. Payer, W. Schmolke, and D. Strube (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Munich, Germany, F.R.) 1991 21 p Submitted for publication
(PB92-108067; EPA/600/D-91/231) Copyright Avail: NTIS HC/MF A03 CSCL 06B

Two approaches are described for the control and measurement of plant functions in environmental chambers; one approach was developed at the US EPA Research Lab., and the other developed at the GSF (Research Center for Environment and Health) in Munich, Germany. Both labs needed experimental studies performed under a variety of physical and chemical conditions that can only be faithfully reproduced in the absence of environmental disturbances, typical of field and greenhouse studies. The different goals of each facility determined the different approaches to control and measurement. Both labs have many ideas that can be useful to researchers studying the interactions associated with plants (botany) and pollutants. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-19031# City Univ. of New York, NY.
THERMAL RESPONSES DURING EXTENDED WATER IMMERSION: COMPARISONS OF REST AND EXERCISE, AND LEVELS OF IMMERSION Final Report
Michael M. Toner and William D. McArdle 10 Nov. 1991 47 p
(Contract DAMD17-88-C-8013; DA Proj. 3E1-62787-A-879)
(AD-A244305) Avail: NTIS HC/MF A03 CSCL 06/4

Phase 1 exposed 14 subjects to the neck in 3 water temperatures during both rest (R) and exercise (E) conditions for up to 3 h; whereas 8 subjects in Phase 2 were exposed to the knee (KN), hip (HI), and chest (CH) in water at 15 and 25 C during R and E. In Phase 1 the pct. Body Fat was 9.5 for the low-fat (L, N=5), 14.8 for the moderate-fat (A, N=5), and 19.6 for the high-fat (H, N=4); subjects were immersed on four occasions (two temperatures X two activities) for durations up to 3 h. During R at equivalent thermal strain, rectal and esophageal temperatures declined similarly in all groups over 3 h. GRA

N92-19087# Maryland Univ., Baltimore. Dept. of Pharmacology and Toxicology.
REGULATION OF BRAIN MUSCARINIC RECEPTORS BY PROTEIN KINASE C Final Report, May 1988 - Jun. 1991
Esam E. El-Fakahany 21 Jun. 1991 9 p
(Contract DAAL03-88-K-0078)
(AD-A244419; ARO-25468.1-LS) Avail: NTIS HC/MF A02 CSCL 06/5

We investigated the pharmacological classification of the subtypes of muscarinic receptors which are coupled to increased hydrolysis of phosphoinositides in rat cerebral cortex. Our results indicated that both M1 and M3 receptors mediate such a response. This response to muscarinic receptor simulation is partially blocked by tetrodotoxin or by protein kinase C activators. The component of the response that is sensitive to blockade by such agents does not correspond to a certain receptor subtype. We investigated the role of protein kinase C in desensitization of muscarinic receptor function in a neuronal clone. While this kinase was clearly involved in the effects of phorbol esters, it did not play a role in agonist-induced receptor desensitization. We also studied some of the molecular events which accompany muscarinic receptor desensitization and down-regulation. These studies indicated that prolonged in vivo treatment of rats with an irreversible acetylcholinesterase decreased the concentration of the mRNA encoding the M2 muscarinic receptor. GRA

N92-19255# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).
MEASUREMENT OF SIGHT DIRECTION IN A CENTRIFUGE. PART 2: EYE MOVEMENT [MESURE DE LA DIRECTION DU REGARD EN CENTRIFUGEUSE. DEUXIEME PARTIE: MOUVEMENT DE L'OEIL]
C. A. Leger, G. DeBenque, C. Desgranges, L. Girardeau, and L. Dizarny-Gargas Dec. 1990 77 p In FRENCH
(Contract DRET-88-1035)
(Rept-1169/CEV/SE/LAMAS; ETN-92-90864) Avail: NTIS HC/MF A05

A helmet mounted system is used to measure eye movements and other visual ergonomic factors during centrifuge tests. The purpose of the system is to determine the resolution, reproducibility, and precision possible with such a system, and identify possible sources of error in such a system. Technical difficulties involved in developing the helmet mounted system were initially underestimated. A more universal solution to the problem of occular illumination is suggested. The drawbacks of existing software for real time analysis are summarized. ESA

N92-19273# Executive Office of the President, Washington, DC. Committee on Interagency Radiation Research and Policy Coordination.
IONIZING RADIATION RISK ASSESSMENT, BEIR 4
Oct. 1991 31 p
(Contract DE-AC05-76OR-00033)
(DE92-004014; ORAU-91/J-20; CIRRPC-8) Avail: NTIS HC/MF A03

This report of the Subpanel discusses the potential impact on Federal agencies and indicates individual risk factors that could be used by them in risk assessment. The approach used in this CIRRPC report was to consider the risk factors presented in BEIR IV for each radionuclide (or group radioelements) and to make some judgments regarding their validity and/or the uncertainties involved. The coverage of Radon-222 and its progeny dominated the BEIR IV report and this Subpanel felt is was proper to devote more attention to this radionuclide family. This risk factor presented in BEIR IV for radon is 350 cancer deaths per million person-working level months (WLM) of exposure for a lifetime. There is a range of opinions on the conversion from WLM to absorbed dose. As discussed in the text, the use of the WLM concept makes it difficult or infeasible to compare the risk factor for radon with that of other radionuclides which are based on organ dose. This report also includes a discussion of certain fundamental scientific and operational issues that may have decisive effect upon risk factor selection. These adjunct items are dealt with under separate headings and include discussions of threshold dose considerations, extrapolation to low doses, and age at exposure. DOE

N92-19333# Defence Research Establishment, Ottawa (Ontario).
INVESTIGATION OF THE EFFECT OF COOLING THE FEET AS A MEANS OF REDUCING THERMAL STRESS
Sydney D. Livingstone and Richard W. Nolan Aug. 1991 14 p
(AD-A244264; DREO-TN-91-15) Avail: NTIS HC/MF A03 CSCL 06/4

The purpose of this investigation was to determine if cooling the feet is as effective as cooling the hands in the alleviation of heat stress. Each of six volunteers dressed in chemical warfare (CW) protective clothing, sat for 120 min in an environment of 35 C and then immersed his feet in a water calorimeter for 20 min. Heat lost to the calorimeter was measured at water temperatures of 10, 15, 20, 25 and 30 C. The use of water-cooled socks was also examined under these environmental conditions. It was found that heat loss from the feet was comparable to that from the hands indicating that the two methods are equally efficient. Preliminary results indicate that the use of water-cooled socks may also be practical. GRA

N92-19347# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).
MEASUREMENT OF SIGHT DIRECTION IN A CENTRIFUGE. PART 1: HEAD MOVEMENT [MESURE DE LA DIRECTION DU REGARD EN CENTRIFUGEUSE. PREMIERE PARTIE: MOUVEMENT DE LA TETE]
G. DeBenque, C. Desgranges, L. Girardeau, and A. Leger Dec. 1990 40 p In FRENCH
(Contract DRET-88-1035)
(Rept-1168/CEV/SE/LAMAS; ETN-92-90865) Avail: NTIS HC/MF A03

The precision of global measurements obtained using an electro-optic helmet mounted aiming system is evaluated. Possible sources of error are determined. The influence of various factors on these sources is outlined. The precision of measurements is evaluated in terms of the efficiency of parallel error correction, reproducibility, and global precision of corrected measurements. Errors of less than one-half of a degree are found in most cases. The global precision, measured by means of one sensor, is better than 0.8 degrees for 95 percent of the measurements carried out. ESA

N92-19689# Veterans Administration Hospital, White River Junction, VT. National Center for Post-Traumatic Stress Disorder.
PILOTS: USER'S GUIDE
Fred Lerner Oct. 1991 71 p
(PB92-100262) Avail: NTIS HC/MF A04 CSCL 06P

The User's Guide is designed to assist librarians and other

experienced database searchers in using the Published International Literature on Traumatic Stress (PILOTS) database and its online equivalent, the Post Traumatic Stress Disorder (PTSD) subfile of the Combined Health Information Database (CHID). It includes a field-by-field guide to searching the database on BRS or using Pro-Cite, as well as the PILOTS Thesaurus. GRA

N92-19702# Health Effects Research Lab., Research Triangle Park, NC.
EVALUATING THE HUMAN HEALTH EFFECTS OF HAZARDOUS WASTES: REPRODUCTION AND DEVELOPMENT, NEUROTOXICITY, GENETIC TOXICITY, AND CANCER
Robert S. Dyer, Virginia S. Houk, and Lawrence W. Reiter 1991 20 p
(PB92-110352; EPA/600/D-91/236) Avail: NTIS HC/MF A03 CSCL 06P

Several approaches are available for characterizing potential toxicity of wastes. The paper describes biological tests which are appropriate for identifying waste as neurotoxic, genotoxic, or likely to produce developmental or reproductive effects. The tests recommended are as follows: for neurotoxicity a functional observational battery, coupled with a measure of motor (bodily movement) activity; for genetic toxicity, the 'Ames' test of mutagenicity in Salmonella and a test of clastogenicity (DNA damage); and for developmental and reproductive toxicity, the Chernoff-Kavlock assay and a multi-generational reproductive assay. In addition, the paper identifies several generic factors which must be considered in performing any evaluations of hazardous wastes. GRA

N92-19761*# Pennsylvania Univ., Philadelphia. Inst. for Environmental Medicine.
PATHOPHYSIOLOGY OF SPONTANEOUS VENOUS GAS EMBOLISM Final Report
C. J. Lambertsen, K. H. Albertine, J. B. Pisarello, and N. D. Flores 10 Nov. 1991 90 p
(Grant NAG9-154)
(NASA-CR-189915; NAS 1.26:189915) Avail: NTIS HC/MF A05 CSCL 06P

The use of controllable degrees and durations of continuous isobaric counterdiffusion venous gas embolism to investigate effects of venous gas embolism upon blood, cardiovascular, and respiratory gas exchange function, as well as pathological effects upon the lung and its microcirculation is discussed. Use of N2O/He counterdiffusion permitted performance of the pathophysiologic and pulmonary microstructural effects at one ATA without hyperbaric or hypobaric exposures. Author

N92-19877# Pennsylvania Univ., Philadelphia. Dept. of Radiology.
EFFECT OF INCREASED AXIAL FIELD OF VIEW ON THE PERFORMANCE OF A VOLUME PET SCANNER
Joel S. Karp, Paul E. Kinahan, Gerd Muehllehner, and Peter Countryman 1991 9 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-FG02-88ER-60642)
(DE92-004424; CONF-911106-34) Avail: NTIS HC/MF A02

The performance of the PENN-PET 240H scanner from UGM Medical Systems is tested and compared to the prototype PENN-PET scanner built at the University of Pennsylvania. The UGM PENN-PET scanner consists of six continuous position-sensitive NaI(Tl) detectors, which results in a 50-cm transverse field-of-view and a 12.8-cm axial field-of-view. The fine spatial sampling in the axial direction allows the data to be sorted into as many as 64 transverse planes, each 2-mm thick. A large axial acceptance angle, without interplane septa, results in a high sensitivity, with a low scatter and random fraction, due to the use of a narrow photopeak energy window. This paper emphasizes those performance measurements that illustrate the special characteristics of a volume imaging scanner and how they change as the axial length is increased. DOE

N92-19952# Pennsylvania State Univ., University Park. Dept. of Chemical Engineering.
NONINVASIVE DETERMINATION OF RESPIRATORY OZONE ABSORPTION: DEVELOPMENT OF A FAST-RESPONDING OZONE ANALYZER Research Report, Jun. 1988 - Apr. 1990
J. S. Ultman and A. Ben-Jebria 1991 35 p Sponsored in part by Health Effects Inst., Cambridge, MA
(PB91-243220; HEI/RR-91/39) Copyright Avail: NTIS HC/MF A03 CSCL 06P

An ozone analyzer and an ozone bolus generator were developed and tested for future use in noninvasive measurements of ozone absorption along human respiratory tract using the bolus-response technique. The analyzer, based on the chemiluminescent reaction of ozone with 2-methyl-2-butene, is sufficiently rapid and sensitive to measure changes in ozone concentration during a 4 second breathing period at quiet respiratory flow rates of 300 mL/sec in humans. Its performance characteristics include a 90 pct. step response time of 110 msec, a linear calibration from 0.03 to 10 ppm ozone, a signal to noise ratio of 30 at 0.5 ppm ozone, and a minimum detection limit of 0.017 ppm ozone. The ozone bolus generator can produce single boluses containing as little as 0.35 micro g ozone in a volume of 19 mL, with a peak ozone fraction of up to 4 ppm. The analyzer and bolus generator were tested in bolus-response experiments at steady air flow rates of 50 to 200 mL/sec in excised pig and sheep tracheas. Twenty-five to 50 pct. of the ozone introduced into the trachea was absorbed. Analysis of the mathematical moments of the bolus input and response curves and comparison to predictions of a diffusion theory indicate that ozone absorption is limited by diffusion processes in the airway lumen. Author

N92-19954# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
RETENTION MODELING OF DIESEL EXHAUST PARTICLES IN RATS AND HUMANS Research Report, Apr. 1987 - Apr. 1990
C. P. Yu and K. J. Yoon 1991 41 p Sponsored in part by Health Effects Inst., Cambridge, MA
(PB91-243238; HEI/RR-91/40) Copyright Avail: NTIS HC/MF A03 CSCL 06P

To study lung clearance, a compartmental model was used consisting of the nasopharyngeal, tracheobronchial, alveolar, and lung associated lymph node compartment. A particle model was assumed made up of material components according to the characteristics of clearance: (1) a carbonaceous core or soot (80 pct. of particle mass); (2) slowly cleared organics (10 pct. pm); and (3) fast cleared organics (10 pct. pm). Kinetic equations of the retention model were first developed for rats. The lung burden calculations showed that although the organics were cleared at nearly constant rates, the alveolar clearance rate of soot decreased with increasing lung burden. At low lung burdens, the alveolar clearance rate was controlled by macrophage migration to the mucociliary escalator, whereas at high lung burdens, the clearance rate was determined by transport to the lymphatics. The retention model for rats was extrapolated to humans of different ages. The reduction in the mechanical clearance in adult humans caused by exposure to high concentrations of diesel exhaust was much less than that observed in rats. The reduction in children was greater than in adults. Author

N92-19956# North Carolina Univ., Chapel Hill.
EFFECTS OF 4 PERCENT AND 6 PERCENT CARBOXYHEMOGLOBIN ON ARRHYTHMIA PRODUCTION IN PATIENTS WITH CORONARY ARTERY DISEASE Research Report, Nov. 1985 - Nov. 1989
D. S. Sheps, M. C. Herbst, A. L. Hinderliter, K. F. Adams, and L. G. Ekelund 1990 66 p Prepared in cooperation with Environmental Protection Agency, Research Triangle Park, NC Sponsored in part by Health Effects Inst., Cambridge, MA
(PB91-243246; HEI/RR-91/41) Copyright Avail: NTIS HC/MF A04 CSCL 06P

The effects were assessed of exposure to carbon monoxide (CO) resulting in 4 or 6 pct. carboxyhemoglobin (COHb) on ventricular arrhythmias in 41 subjects (nonsmokers) with

documented coronary artery disease. Subjects were exposed to room air, 100 ppm CO (target, 4 pct. blood COHb), or 200 ppm CO (target, 6 pct. blood COHb), and then did a supine bicycle exercise test. Radionuclide ventriculography was performed at rest and during exercise. Ambulatory electrocardiogram recordings were made to determine the frequency of premature ventricular contractions (PVCs). The frequency of single and multiple PVCs per hour during exercise was significantly greater on the 6 pct. COHb day than on the room air day (for single PVCs, 167.72 + or - 37.99 for 6 pct. COHb compared with 127.32 + or - 28.22 for room air, p = 0.03; for multiple PVCs, 9.59 + or - 3.70 for 6 pct. COHb day compared with 3.18 + or - 1.67 for the room air day, p = 0.02). Patients who developed increased arrhythmias were significantly older than those who had a higher peak workload during. No effects of CO exposure was seen on the 6 pct. COHb day for subjects at rest, or on the 4 pct. COHb day. Author

N92-19957# Midwest Research Inst., Golden, CO. Life Sciences Dept.
EFFECTS OF METHANOL VAPOR ON HUMAN NEUROBEHAVIORAL MEASURES Research Report, Jul. 1988 - Oct. 1990
M. R. Cook, F. J. Bergman, H. D. Cohen, M. M. Gerkovich, and C. Graham 1991 65 p Sponsored in part by Health Effects Inst., Cambridge, MA
(PB91-243253; HEI/RR-91/42) Copyright Avail: NTIS HC/MF A04 CSCL 06P

Methanol may become an important alternative fuel for vehicles in the near future. The objective of the preliminary study was to determine if inhalation exposure to methanol, near the maximum concentration allowed for an eight hour average exposure in the workplace (200 ppm), would have adverse effects on human neurobehavioral functions. Twelve healthy young men were exposed twice to filtered air and twice to 192 ppm methanol vapors for 75 minutes on different days under double blind conditions. Twenty two neurobehavioral and neurophysiolocal tests were administered before, during, and after exposure to measure visual, behavioral, reasoning, and hearing functions. Exposure to methanol produced significant increases in blood and urine methanol concentration at the end of the exposure period. As expected, no changes in plasma formate were observed. Methanol exposure had no effect on the subjects' performance on most of the tests. However, some methanol exposed subjects reported more fatigue and lack of concentration. Performance was also slightly impaired on the Sternberg memory task. These effects were small and did not exceed the range of results measured in filtered air exposed subjects. Author

N92-19977*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CREW FACTORS IN FLIGHT OPERATIONS. 8: FACTORS INFLUENCING SLEEP TIMING AND SUBJECTIVE SLEEP QUALITY IN COMMERCIAL LONG-HAUL FLIGHT CREWS
Philippa H. Gander, R. Curtis Graeber, Linda J. Connell, and Kevin B. Gregory (Sterling Software, Palo Alto, CA.) Dec. 1991 41 p
(NASA-TM-103852; A-91106; NAS 1.15:103852) Avail: NTIS HC/MF A03 CSCL 06P

How flight crews organize their sleep during layovers on long-haul trips is documented. Additionally, environmental and physiological constraints on sleep are examined. In the trips studied, duty periods averaging 10.3 hr alternated with layovers averaging 24.8 hr, which typically included two subject-defined sleep episodes. The circadian system had a greater influence on the timing and duration of first-sleeps than second-sleeps. There was also a preference for sleeping during the local night. The time of falling asleep for second-sleeps was related primarily to the amount of sleep already obtained in the layover, and their duration depended on the amount of time remaining in the layover. For both first- and second-sleeps, sleep durations were longer when subjects fell asleep earlier with respect to the minimum of the circadian temperature cycle. Naps reported during layovers and on the flight deck may be a useful strategy for reducing cumulative sleep loss. The circadian system was not able to synchronize with the rapid series of time-zone shifts. The sleep/wake cycle was forced to adopt a period different from that of the circadian system. Flight and duty time regulations are a means of ensuring that reasonable minimum rest periods are provided. This study clearly documents that there are physiologically and environmentally determined preferred sleep times within a layover. The actual time available for sleep is thus less than the scheduled rest period. Author

N92-20020# National Inst. for Occupational Safety and Health, Cincinnati, OH.
DEVELOPMENT OF A LUNG-CELL MODEL FOR STUDYING WORKPLACE GENOTOXICANTS Final Report
W. Z. Whong 1991 25 p
(PB92-114644) Avail: NTIS HC/MF A03 CSCL 06P

The objectives were to establish in-vivo and/or in-vitro multiple genetic endpoint assay systems using lung cells of the rat, to compare the sensitivity of rat lung cells to genotoxicants between in-vivo and in-vitro assay systems, and to evaluate the suitability of the multiple genetic endpoint/lung cell assay system for detecting genotoxicity. Male CD-rats were used. Results indicated that the best enzymatic separation of rat lung cells was a combined treatment of lung with trypsin and collagenase or a cold digestion with protease. Two micrograms cytochalasin-B/mm for two days incubation was the optimal protocol for cytokinesis block in lung cells during micronucleus formation (MN) assay. Primary lung cells can be used for in-vivo and in-vitro sister chromatic exchange and MN analyses. A minimal 16 hour cell incubation in the presence of tritium labeled thymidine was required for visualization of optimal DNA repair in the lung cells/unscheduled DNA synthesis (UDS) assay system. Both alveolar macrophages and primary lung cells could be used for in-vivo and in-vitro UDS assays. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-19064# Health Research, Inc., Albany, NY.
ACTIVITY-DRIVEN CNS CHANGES IN LEARNING AND DEVELOPMENT Final Report, 15 Apr. 1990 - 14 Apr. 1991
Jonathan R. Wolpaw 14 Apr. 1991 413 p
(Grant AF-AFOSR-0238-90; AF Proj. 2312)
(AD-A243790; AFOSR-91-0937TR) Avail: NTIS HC/MF A18 CSCL 05/8

The conference that formed the basis for the present volume took place in May, 1990 at the Rensselaerville Institute in Rensselaerville, New York near Albany. This last meeting reflected the increased pace and breadth of recent research. Most important, it added a new theme to the two stressed before: Its central goal was to discuss, in a connected fashion, the entire sequence of events underlying learning and development. Such a comprehensive and logical format has only become possible in the last few years. Before that, knowledge was too fragmentary to permit meaningful adherence to this framework. At the same time, recent advances have made it imperative to encourage interactions between scientists working at each level in this sequence, if understanding of learning and development is not to remain disjointed and compartmentalized. To emphasize this theme, the meeting's organization paralleled the progression from neuronal activity to altered behavior. Thus, the first session described receptormediated triggers of plasticity, the second discussed accompanying molecular events, the next two evaluated synaptic modifications resulting from these events, and the last two evaluated expression of these synaptic modifications as altered behavior of neural networks and whole animals. GRA

N92-19069# New York Univ., New York. Neuromagnetism Lab.
ATTENTION, IMAGERY AND MEMORY: A NEUROMAGNETIC INVESTIGATION Final Report, 1 Mar. 1988 - 30 Sep. 1991
Lloyd Kaufman and Samuel J. Williamson 14 Oct. 1991 123 p

(Contract F49620-88-K-0004)
(AD-A243859; AFOSR-91-0970TR) Avail: NTIS HC/MF A06 CSCL 05/8

The techniques of magnetic source imaging (MSI) have been applied to studies of three important aspects of human cognition: (1) An investigation of the effects of selective spatial attention on information processing within the human visual cortex for stimuli of constant luminance have revealed that early response components from 120 to 180 ms latency provide evidence for such effects, but amplitude enhancements for later components are probably related to pattern recognition and task-relevant stimulus discrimination; (2) A study of the relationship between the performance of a cognitive task such as visual imagery, or silent rhyming, and the suppression of spontaneous cortical rhythms reveals that the location, onset time, and duration of suppression are task specific and correlate with measures of performance; and (3) The characterization of the functional attributes of neuronal activity in human auditory association cortex provides evidence that cortical activation traces in primary and association areas can be accurately characterized by distinct lifetimes, which typically amount to several seconds, and that these sensor memories characterize specific physical attributes of sound. GRA

N92-19083# Wisconsin Univ., Madison. Dept. of Computer Sciences.
BEHAVIOR AND LEARNING IN NETWORKS WITH DIFFERING AMOUNTS OF STRUCTURE Final Report, 1 Dec. 1988 - 30 Nov. 1990
Leonard Uhr 9 Sep. 1991 28 p
(Grant AF-AFOSR-0178-89; AF Proj. 2305)
(AD-A244080; UW-144-AS50; AFOSR-91-0939TR) Avail: NTIS HC/MF A03 CSCL 05/8

This research is investigating how well large networks that are built from neuron-like elements can be made to perform and learn to perform by giving them different types and amounts of built in structure and the ability to learn by generating new nodes in additions to changing weights. Substantial improvements in both learning speed and performance have been achieved on both pattern recognition problems and a range of problems typically used to demonstrate the power of connectionist networks. In addition, a number of new microcircuits and subnetworks have been specified with which more powerful and more flexible networks can be built. These include: back-cycling nets that handle learning (along with many useful functions), rather than having learning handled by the system that executes the net; nets that handle symbols as well as numbers; and microcircuits for productions and perceptual transforms. GRA

N92-19364# Mei Associates, Inc., San Antonio, TX.
CHARACTERIZATION OF AIR FORCE TRAINING AND COMPUTER-BASED TRAINING SYSTEMS Final Report, Mar. 1990 - Jul. 1991
William J. Walsh, Patricia J. Yee, and Steven A. Young Dec. 1991 237 p
(Contract F33615-88-C-0003)
(AD-A243781; AL-TP-1991-0048) Avail: NTIS HC/MF A11 CSCL 06/5

This paper documents the approach used in the development of guidelines designed to aid novice training managers in the computer-based training (CBT) system planning, selection and implementation process. Phase 1 developed a list of critical factors that characterized Air Force training organizations and CBT technologies. These factors were developed at a level simple enough so misinterpretation by novice managers was minimized. Next, decision processes were merged with identified factors forming guidelines that followed an input-process-output model. These preliminary guidelines were field-tested during Phase 2 at four Air Force training organizations. Concurrent with field-testing, the guidelines were validated by convening a panel of Air Force CBT 'experts' to critique the guidelines and compare their CBT development processes with those of the guidelines. Following these efforts, the guidelines were revised and refined. GRA

N92-19365# Case Western Reserve Univ., Cleveland, OH. Dept. of Psychology.
RESPONSE DEVICES AND COGNITIVE TASKS Annual Report, 16 Jun. 1990 - 30 Oct. 1991
Douglas K. Detterman 30 Oct. 1991 6 p
(Grant AF-AFOSR-0084-90; AF Proj. 2313)
(AD-A243903; AFOSR-91-0984TR) Avail: NTIS HC/MF A02 CSCL 05/8

The aims of the research are to study the effects of response mode, response complexity, instructions and practice on basic cognitive tasks, and to use the information obtained to develop more elaborated models of cognitive functioning which take these factors into account. To accomplish these aims, subjects will be tested on a set of computer-administered cognitive tasks, using keyboard and touch screen response modes, and under varying sets of verbal and nonverbal instructions. GRA

N92-19410# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
THE CONSTRUCTION OF PERSONALITY QUESTIONNAIRES FOR SELECTION OF AVIATION PERSONNEL
Klaus-Martin Goeters and Bernd Timmermann Mar. 1991 42 p
(DLR-FB-91-18; ISSN-0939-2963; ETN-92-90735) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 16 DM

The Personality Research Form (PRF), a questionnaire for voluntary self description, was administered to a group of 300 applicants for pilot training at a major European airline. Standard psychometric statistics were computed for the PRF subscales. The comparison with information given in the test manual shows that the reliabilities of all PRF subscales decline in personnel selection. Strong ceiling effects which were caused by response sets (mainly social desirability) are identified as the reason for this phenomenon. Besides the PRF the Temperament Structure Scales (TSS) were presented to the same group. The TSS is a questionnaire which is constructed for selection conditions. The computed factor analytic results indicate that its factor structure is very similar to that of the PRF. No detrimental downward trend could be revealed for the scale reliabilities of the TSS. Thus, it seems possible to construct questionnaires which are robust with respect to selection conditions. ESA

N92-19799# Wake Forest Univ., Winston-Salem, NC. Dept. of Physiology and Pharmacology.
RECEPTOR SUBTYPE ALTERATIONS: BASES OF NEURONAL PLASTICITY AND LEARNING Final Technical Report
Brent A. Vogt 3 Dec. 1991 12 p
(Grant AF-AFOSR-0372-90; AF Proj. 2312)
(AD-A244406; AFOSR-91-1028TR) Avail: NTIS HC/MF A03 CSCL 05/8

The following findings were reported: (1) oxotremorine-m binding in rabbit thalamus and cingulate cortex increased during discriminative avoidance conditioning (DAC); (2) excitatory and discriminative neuronal activity was documented throughout DAC and there were relationships between training-induced neuronal activity and changes in binding; (3) turnover of noradrenaline was significantly elevated during DAC suggesting a role for this transmitter in long-term memory; (4) anterior cingulate cortex lesions uncover discriminative neuronal activity in the striatum and amplify activity in thalamus; (5) the structure connections and spontaneous activity of the lateral magnocellular nucleus in thalamus were described; and (6) a review was written of the structure and function of cortical layer I and its role in learning and memory analyzed. These are the first studies to document physiological regulation of receptors and transmitters that occur during avoidance learning and provide the basis for a comprehensive analysis of the molecular bases for learning and memory. GRA

N92-20037# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
HUMAN PERFORMANCE ASSESSMENT METHODS
May 1989 73 p
(AGARD-AG-308; ISBN-92-835-0510-7) Copyright Avail: NTIS HC/MF A04; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The goal was to develop the 'Standardized Tests for Research on Environmental Stressors' or 'STRES' Battery, satisfying conventional psychometric criteria such as reliability, validity, and sensitivity for which an extensive data base may now be compiled among the NATO nations. The protocol for the 7 selected tests is presented. Author

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-19179# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
APPLICATION OF FINITE ELEMENT MODELING AND ANALYSIS TO THE DESIGN OF POSITIVE PRESSURE OXYGEN MASKS M.S. Thesis
Bruce H. Bitterman Dec. 1991 127 p
(AD-A244045; AFIT/GAE/ENY/91D-22) Avail: NTIS HC/MF A07 CSCL 05/8

This study investigated tools and techniques for performing finite element analysis of the MBU-20/P pilot's oxygen mask. The problem which was investigated was the fit of the mask to the face at Positive Pressure Breathing (PPB) pressures. Deformed geometry of the mask and reaction forces on the face were calculated to provide a measure of the fit. The MBU-20/P mask was first digitized by 3-D digitizer. A computer program was written to translate the digitized coordinate data to a finite element format for two commercial packages. The packages targeted were SDRC I-DEAS and PDA PATRAN. Other supplementary programs were written to perform some functions which would have been difficult to accomplish within the commercial codes. The tools and techniques developed are applicable to a wide class of problems, beyond the specific application to the oxygen mask analysis. They provide a capability to rapidly develop finite element models from existing prototypes for redesign, detailed analysis, or reverse engineering. GRA

N92-19447# Center for Night Vision and Electro-Optics, Fort Belvoir, VA.
COMPARISON OF SECOND AND THIRD GENERATION NIGHT VISION GOGGLES IN TIME-LIMITED SCENARIOS Final Report
Edward J. Bender, Charles E. Bradford, and Raymond J. Stefanik Jul. 1991 97 p
(AD-A244330; AMSEL-NV-TR-0080) Avail: NTIS HC/MF A05 CSCL 17/5

This report addresses eight nights of field testing which occurred at three sites (pine canopy, cluttered range, open meadow) in the Deschutes National Forest, OR, during May 1988. The primary objective of these field evaluations was to characterize changes in detection performance of second and third generation Night Vision Goggles. These changes were to be examined as a function of both allowed observation time and progressive user fatigue. GRA

N92-19772*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A METHOD OF EVALUATING EFFICIENCY DURING SPACE-SUITED WORK IN A NEUTRAL BUOYANCY ENVIRONMENT
Michael C. Greenisen, Phillip West, Frederick K. Newton, John H. Gilbert, and William G. Squires (Texas Lutheran Coll., Seguin.) Oct. 1991 11 p
(NASA-TP-3153; S-648; NAS 1.60:3153) Avail: NTIS HC/MF A03 CSCL 05H

The purpose was to investigate efficiency as related to the work transmission and the metabolic cost of various extravehicular activity (EVA) tasks during simulated microgravity (whole body water immersion) using three space suits. Two new prototype space station suits, AX-5 and MKIII, are pressurized at 57.2 kPa and were tested concurrently with the operationally used 29.6 kPa shuttle suit. Four male astronauts were asked to perform a fatigue trial on four upper extremity exercises during which metabolic rate and work output were measured and efficiency was calculated in each suit. The activities were selected to simulate actual EVA tasks. The test article was an underwater dynamometry system to which the astronauts were secured by foot restraints. All metabolic data was acquired, calculated, and stored using a computerized indirect calorimetry system connected to the suit ventilation/gas supply control console. During the efficiency testing, steady state metabolic rate could be evaluated as well as work transmitted to the dynamometer. Mechanical efficiency could then be calculated for each astronaut in each suit performing each movement. Author

N92-19808# Galaxy Scientific Corp., Mays Landing, NJ.
HUMAN FACTORS IN AVIATION MAINTENANCE, PHASE 1 Interim Report, Sep. 1989 - Jan. 1991
William T. Shepherd, William B. Johnson, Colin G. Druray, James C. Taylor, and Daniel Berninger Nov. 1991 168 p
(AD-A243844; DOT/FAA/AM-91/16) Avail: NTIS HC/MF A08 CSCL 01/3

This human factors research in aviation maintenance addresses four tasks including studies of organizational behavior, job and task analysis in maintenance and inspection, advanced technology for training, and the application of job aiding to maintenance. The first phase of a three phase research program describes extensive preliminary investigation of airline maintenance practices. Each chapter describes the Phase 1 investigation and problem definition followed by the plan for the Phase 2 demonstrations. GRA

N92-19829# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
HORIZONTAL IMPACT TESTS OF THE ADVANCED DYNAMIC ANTHROPOMORPHIC MANIKIN (ADAM) Final Report, 1 Nov. - 30 Dec. 1988
Joseph P. Strzelecki and John R. Buhrman Apr. 1991 126 p
(AF Proj. 2868; AF Proj. 7231)
(AD-A243857; AL-TR-1991-0096) Avail: NTIS HC/MF A07 CSCL 05/8

Forty four tests were conducted to demonstrate the structural integrity, functional capability, and stability of the electronics under impact conditions of up to -40 Gx and +14 Gy. The CREST ejection seat configuration was used along with two versions of the CREST X-Band harness. Test results indicated the Anthropomorphic Manikins are structurally sound but prone to circuit board and wiring failures. The capability of the ADAMs to reproduce specific dynamic response of human subjects taken as a whole was good, but the accuracy of the instrumentation was not able to provide measurements consistently within five percent of the true value. GRA

N92-19926# Centre d'Etudes et de Recherches Bio-Physiologiques Appliquees a la Marine, Toulon (France). Div. d'Electrophysiologie et Psychophysiologie.
DEVELOPMENT OF AN ELECTROMYOGRAPHY AND ACCELEROMETRY AMBULATORY RECORDING SYSTEM [MISE AU POINT D'UN SYSTEME D'ENREGISTREMENT AMBULATOIRE D'ELECTROMYOGRAPHIE ET D'ACCELEROMETRIE]
J. Grapperon, F. Lorenzo, F. Vidal, S. C. P. Pittet, D. Bruschera, D. Villard, and A. Trousset May 1991 15 p In FRENCH; ENGLISH summary

(Contract DRET-91-1012-J)
(CERB-91-07; ETN-92-91083) Avail: NTIS HC/MF A03

An ambulatory recorder was developed to record, in aircraft, cervical electromyogram and acceleration along two axes measured on the helmet. The work consisted of the adaptation of a pre-existing polygraphic recorder (Mediiog 9000). Its working under acceleration was checked, and outputs with those obtained from a laboratory recorder were compared. ESA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-19260*# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
HIGH PERFORMANCE NETWORK AND CHANNEL-BASED STORAGE
Randy H. Katz Sep. 1991 42 p Sponsored in part by DARPA; State of California MICRO Program; DEC; Emulex; Exabyte; IBM; NCR; and Storage Technology Corp.
(Grant NAG2-591)
(NASA-CR-189965; NAS 1.26:189965; UCB/CSD-91/650) Avail: NTIS HC/MF A03 CSCL 09B

In the traditional mainframe-centered view of a computer system, storage devices are coupled to the system through complex hardware subsystems called input/output (I/O) channels. With the dramatic shift towards workstation-based computing, and its associated client/server model of computation, storage facilities are now found attached to file servers and distributed throughout the network. We discuss the underlying technology trends that are leading to high performance network-based storage, namely advances in networks, storage devices, and I/O controller and server architectures. We review several commercial systems and research prototypes that are leading to a new approach to high performance computing based on network-attached storage. Author

N92-19261*# California Univ., Berkeley. Div. of Computer Science.
AN ANALYTIC PERFORMANCE MODEL OF DISK ARRAYS AND ITS APPLICATION
Edward K. Lee and Randy H. Katz Nov. 1991 22 p Sponsored in part by Array Technologies; DARPA; DEC; Hewlett-Packard; IBM; Intel Scientific Computers; California MICRO; Seagate; Storage Tek; Sun Microsystems; and Thinking Machines Corp.
(Grants NAG2-591; NSF MIP-87-15235)
(NASA-CR-189964; NAS 1.26:189964; UCB/CSD-91/660) Avail: NTIS HC/MF A03 CSCL 09B

As disk arrays become widely used, tools for understanding and analyzing their performance become increasingly important. In particular, performance models can be invaluable in both configuring and designing disk arrays. Accurate analytic performance models are desirable over other types of models because they can be quickly evaluated, are applicable under a wide range of system and workload parameters, and can be manipulated by a range of mathematical techniques. Unfortunately, analytical performance models of disk arrays are difficult to formulate due to the presence of queuing and fork-join synchronization; a disk array request is broken up into independent disk requests which must all complete to satisfy the original request. We develop, validate, and apply an analytic performance model for disk arrays. We derive simple equations for approximating their utilization, response time, and throughput. We then validate the analytic model via simulation and investigate the accuracy of each approximation used in deriving the analytical model. Finally, we apply the analytical model to derive an equation for the optimal unit of data striping in disk arrays. Author

N92-19278# Boston Univ., MA. Center for Adaptive Systems.
REAL-TIME IMAGE PROCESSING ARCHITECTURES FOR PERCEPTUAL GROUPING, DEPTH SEGREGATION, AND OBJECT RECOGNITION Final Report, 1 Jun. 1988 - 31 Aug. 1991
Stephen Grossberg Nov. 1991 10 p
(Contract DAAL03-88-K-0088)
(AD-A244105; ARO-25662.9-MA) Avail: NTIS HC/MF A02 CSCL 05/8

The development of real-time neural architectures capable of performing autonomous image processing and pattern recognition tasks in noisy and random environments was the goal of this research program. Such architectures are needed to cope with the fact that, in naturally occurring scenes, edge, texture, shading, size, stereo, and motion information are often overlaid and are viewed under variable illumination conditions. Special-purpose vision algorithms that can process only one of these types of information do not function well under naturally occurring conditions. The present work has analyzed a large body of data from visual psychophysics and neurobiology in order to discover and test neural principles and mechanisms whereby such a general-purpose competence is achieved by humans and animals. These designs are embodied in multi-level neural networks which are defined by novel types of nonlinear dynamical systems. The networks are computationally characterized for use both in explaining biological data about vision and pattern recognition, and in implementing novel image processing circuits for use in technological applications. Predictions of the theory have also been successfully tested in our psychophysics laboratory. GRA

N92-19281# Duke Univ., Durham, NC. Dept. of Computer Science.
ON THE ERRORS THAT LEARNING MACHINES WILL MAKE
A. W. Biermann, K. C. Gilbert, A. Fahmy, and B. Koster Mar. 1991 57 p Revised
(Contract DAAL03-88-K-0082)
(AD-A244108; CS-1991-32; ARO-25195.10-MA-AI) Avail: NTIS HC/MF A04 CSCL 12/9

Associated with each learning system there is a class of learnable behaviors. If the target behavior to be acquired is in the learnable class, it will be learned perfectly. If it is outside that class, the machine will only be able to acquire a behavior that approximates the target and it will always make errors. It is desirable for a learning machine to have a large learnable class to maximize the chances of acquiring the unknown behavior and to minimize the expected error when only an approximation is possible. However, it is also desirable to have a small learnable class so that learning can be achieved rapidly. Thus the design of learning machines involves selecting a position on the spectrum: minimum error and slow learning time versus larger error and faster learning

time. Machines that have fast learning times, relatively small learnable classes, and thus relatively large expected errors are called realization sparse in this paper. It is shown that many common learning systems are of this type including signature tables, linear system models, and conjunctive normal form expression based systems. These studies lead to the concept of an optimum machine which spreads its learnable behaviors across the behavior space in a manner to minimize the expected error. An approximation to such optimum machines is presented and its behavior is compared to the more traditional learning machines. GRA

N92-19288*# California Univ., Berkeley. Computer Science Div.
REDUNDANT DISK ARRAYS: RELIABLE, PARALLEL SECONDARY STORAGE Ph.D. Thesis
Garth Alan Gibson Dec. 1990 267 p
(Grant NAG2-591)
(NASA-CR-189962; NAS 1.26:189962; UCB/CSD-91/613)
Copyright Avail: NTIS HC/MF A12 CSCL 09B

During the past decade, advances in processor and memory technology have given rise to increases in computational performance that far outstrip increases in the performance of secondary storage technology. Coupled with emerging small-disk technology, disk arrays provide the cost, volume, and capacity of current disk subsystems, by leveraging parallelism, many times their performance. Unfortunately, arrays of small disks may have much higher failure rates than the single large disks they replace. Redundant arrays of inexpensive disks (RAID) use simple redundancy schemes to provide high data reliability. The data encoding, performance, and reliability of redundant disk arrays are investigated. Organizing redundant data into a disk array is treated as a coding problem. Among alternatives examined, codes as simple as parity are shown to effectively correct single, self-identifying disk failures. Author

N92-19363*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
TECHNOLOGY DEVELOPMENT: A PARTNERSHIP THAT MAKES SENSE
Kyle Y. Rone, Robert B. MacDonald (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.), and A. Glen Houston 18 Jun. 1991 16 p
(Contract NCC9-16)
(NASA-CR-189935; NAS 1.26:189935) Avail: NTIS HC/MF A03 CSCL 09B

Discussed here is an approach to how academic institutions, government entities, and industrial organizations can work effectively to utilize their relative strengths to more effectively meet common goals. The discussion relates to the University of Houston-Clear Lake (UHCL) Research Institute for Computing and Information Systems (RICIS) Program to bring about this type of triad in the Clear Lake area. It is concluded that the interfaces among these groups must remain independent to maintain a healthy counterbalance to their respective entities. However, each entity can and must understand the entire mechanism to exploit each interface to the fullest. Only through such cooperation can the continued technical success of the NASA/Clear Lake area be assured. Author

N92-19441# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SECURITY GUIDE FOR UNIX (TM) SYSTEM MANAGERS
Christian Pelissier 1991 120 p In FRENCH; ENGLISH summary Translation was announced as ESA-TT-1277
(ONERA-NT-1991-7; ISSN-0078-3781; ETN-92-91028) Avail: NTIS HC/MF A06

The aim of the analysis is to improve the knowledge of non specialist users in security problems. The work was written for UNIX system administrators, managing large local area networks opened on public networks. The following points are included: access allowance algorithms, login identification conditions, interface software, electronic data transmission, coding rules, system's protection, ciphering. Security treated here is operating system one against various threats like Trojan Horses, viruses, logical bombs. It does not concern physical security of the operating system against natural disaster, fire and water damages. Methods and strategies to use for backups are not part of tackled subjects. ESA

N92-19585# Tilburg Univ. (Netherlands). Dept. of Economics.
VECTOR COMPUTERS, MONTE CARLO SIMULATION, AND REGRESSION ANALYSIS: AN INTRODUCTION
Jack P. C. Kleijnen and Ben Annink May 1990 31 p Sponsored in part by Rutgers - The State Univ.
(FEW-443; ETN-92-90886) Avail: NTIS HC/MF A03

Vector computers provide a new tool for management scientists. The application of that tool requires thinking in vector mode. This mode is examined in the context of Monte Carlo experiments with regression models; these regression models serve as metamodels in simulation experiments. The vector mode needs to exploit a specific dimension of the Monte Carlo experiment. Taking advantage of the machine architecture gives code that computes ordinary least squares estimates on a CYBER 205 in 2 pct. of the time needed on a VAX 8700. For generalized least squares estimates, the code runs slower in the CYBER 205 than in the VAX, if the regression model is small; for large models the CYBER 205 runs much faster. ESA

N92-19586# Tilburg Univ. (Netherlands). Dept. of Economics.
SUPERCOMPUTERS FOR MONTE CARLO SIMULATION: CROSS-VALIDATION VERSUS RAO'S TEST IN MULTIVARIATE REGRESSION
Jack P. C. Kleijnen Jun. 1990 24 p Presented at the International Conference on Bootstrapping and Related Techniques, Trier, Fed. Republic of Germany, 4-8 Jun. 1990
(FEW-447; ETN-92-90887) Avail: NTIS HC/MF A03

Supercomputers, especially vector computers, which require thinking in vector mode and regression models with dependent errors are addressed. The vector mode is examined in the context of Monte Carlo experiments with regression models. The vector mode needs to exploit a specific dimension of the Monte Carlo experiment, namely its replicates. The resulting code computes ordinary least squares estimates on a CYBER 205 in 2 pct. of the time needed on a VAX 8700. For generalized least squares estimates, however, the code runs slower on the CYBER 205 than in the VAX, if the regression model is small; for large models the CYBER 205 runs much faster. To test the validity of the specified regression model, Rao (1959) generalized the F statistic for lack of fit, whereas Kleijnen (1983) proposed cross validation using Student's statistic combined with Bonferroni's inequality. An extensive Monte Carlo experiment compares these two methods. Whereas cross validation turns out to be conservative. Rao's test realizes its nominal alpha errors and has high power. The Monte Carlo experiment further compares several confidence interval procedures for individual regression parameters. ESA

N92-19597# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
A HIGH-SPEED SLOTTED RING ACCESS MECHANISM WITH DYNAMICALLY ADAPTIVE SLOT SIZES
H. L. Pasch and I. G. Niemegeers Apr. 1991 8 p
(Memo-INF-91-27; TIOS-91/009; ISSN-0923-1714; ETN-92-90892)
Avail: NTIS HC/MF A02

Two access mechanisms complementary in performance are the token ring and the slotted ring. While the token ring outperforms the slotted ring for long messages, the latter performs significantly better for short messages. The factor that causes this difference is (as shown) the number of tokens in the ring. A new network design is proposed in which the number of tokens was made adaptive, resulting in a network that can be made to behave like both the token ring and the slotted ring, or anything in between, i.e., it performs optimally for any given message length. First simulation results that show the performance gain that is achieved by using the principle are presented. The concept of transmission interruption is introduced. It intends to approach the shortest-job-next premptive-resume service discipline globally

throughout the network in order to further minimize the mean transfer delay in case of a load consisting of a mixture of message lengths. ESA

N92-19729# Technical Imaging Services, Inc., Jackson, NJ.
NOVEL OPTICAL COMPUTER ARCHITECTURE UTILIZING RECONFIGURABLE INTERCONNECTS Final Report, 1 Jul. - 1 Oct. 1991
Miles Murdocca, Apostolos Gerasoulis, and Saul Levy 1 Oct. 1991 65 p
(Contract F49620-91-C-0055)
(AD-A244057; TR-100191.01) Avail: NTIS HC/MF A04 CSCL 12/6

This final report describes progress made by TIS Incorporated for the period 7/1/91 to 10/1/91 toward the development of novel optical computer architectures and supporting methods for exploiting free-space reconfigurable interconnects. Major findings include: (1) Reconfigurable interconnects can reconfigure slower than the bit rate and still improve performance as long as throughput is maintained after reconfiguration; (2) A fixed control sequence does not preclude the use of runtime conditionals, so that the performance of traditional general purpose computing can be improved; (3) A system that uses reconfigurable interconnects is likely to be larger than a functionally equivalent system that does not use reconfigurable interconnects; (4) A reconfigurable approach is most effective for a small active portion of a computer, and is not needed for an entire computer in order to appreciate a performance gain; (5) A reconfigurable interconnect technology can have a significant impact on interconnection networks used in parallel processors; (6) A fixed control sequence must have some level of repetition in order to be practical; and (7) The dataflow model of computing, which theoretically supports maximum parallelism but suffers performance sacrifices in electronic implementations, may be significantly improved since the architecture can be modified to suit the dataflow graph. GRA

N92-19810# Mitre Corp., Bedford, MA.
SUPERCONDUCTING ANALOG TO DIGITAL CONVERTERS Final Report
Joel M. Schoen, ed. Sep. 1991 359 p
(AD-A244031) Avail: NTIS HC/MF A16 CSCL 20/12

Investigations of superconducting electronics are described. The stimulus for this work was the discovery of superconductivity at temperatures above that of liquid nitrogen. This discovery suggested that more economic supreconducting electronic systems were feasible. The phenomena associated with superconductivity, Josephson junctions, and superconducting quantum interference devices (SQUIDS) are briefly described. Various techniques to perform analog-to-digital conversion using these phenomena are reviewed. GRA

N92-19830# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.
FAULT TOLERANT ARCHITECTURES FOR MULTIPROCESSORS AND VLSI-BASED SYSTEMS Final Report, 1 May 1988 - 29 Sep. 1991
Dhiraj K. Pradhan 29 Sep. 1991 30 p
(Grant AF-AFOSR-0205-88; AF Proj. 2301)
(AD-A244034; AFOSR-91-0950TR) Avail: NTIS HC/MF A03 CSCL 12/6

A general framework for shift register-based test response compressors was developed based on algebraic coding theory. It has advantages over Markov modeling in allowing exact computation of aliasing probability and extension to other forms of built-in self-test. The use of deBruijn graphs was adopted to studies of VLSI-based multiprocessor networks. These allowed derivation of lower bounds on VLSI layout areas and provided a method to meet those bounds. The graphs were extended to hyper-de Bruijn networks. Finally a design was produced for fault-tolerant testable RAM's (TRAM's). GRA

N92-19836*# California Univ., Berkeley. Div. of Computer Science.
TRANSPARENT PROCESS MIGRATION: DESIGN ALTERNATIVES AND THE SPRITE IMPLEMENTATION
Fred Douglis and John Ousterhout Feb. 1991 33 p
(Contract NAG2-591; N00039-85-C-0269; NSF ECS-83-51961)
(NASA-CR-189966; NAS 1.26:189966) Avail: NTIS HC/MF A03 CSCL 09B

The Sprite operating system allows executing processes to be moved between hosts at any time. We use this process migration mechanism to offload work onto idle machines, and also to evict migrated processes when idle workstations are reclaimed by their owners. Sprite's migration mechanism provides a high degree of transparency both for migrated processes and for users. Idle machines are identified, and eviction is invoked, automatically by daemon processes. On Sprite it takes up to a few hundred milliseconds on SPARCstation 1 workstations to perform a remote exec, while evictions typically occur in a few seconds. The pmake program uses remote invocation to invoke tasks concurrently. Compilations commonly obtain speedup factors in the range of three to six; they are limited primarily by contention for centralized resources such as file servers. CPU-bound tasks such as simulations can make more effective use of idle hosts, obtaining as much as eight-fold speedup over a period of hours. Process migration has been in regular service for over two years. Author

N92-20005# National Research Council of Canada, Ottawa (Ontario). Div. of Electrical Engineering.
MANAGING CONFIGURABILITY IN MULTI-INSTALLATION REALTIME PROGRAMS
W. Morven Gentleman Nov. 1989 11 p Presented at the Canadian Conference on Electrical and Computer Engineering, Vancouver, British Columbia, 3-4 Nov. 1989
(NRC-30938; ERB-1024; CTN-92-60393) Avail: NTIS HC/MF A03

Realtime programs installed in many sites have aspects that cause installation, maintenance, and evolution to be labor intensive if approached with conventional tools and techniques. A discussion of these difficulties is provided along with a review of tools and techniques which are available to address them. Special emphasis is placed on the Harmony Operating system. Support of multiple installation applications is a major objective of Harmony. The operating system is structured as a minimal kernel with a software bus whereby other services are provided by tasks called servers. The server can be structured as appropriate rather than having to conform to a strict template as do device drivers for conventional operating systems. The system uses dynamic name binding to facilitate connection flexibility. The modular structure makes servers easy to write and robust to system changes. Harmony technology includes a novel source management methodology to assist in managing codes for programs with many variations and in realizing specific versions. Portability is treated as just one more cause for variation in programs. A program is defined by separate static configuration tables specifying the executable image for each processor. The file system directory structure used for Harmony example programs has proved extremely effective in managing the support of many different program versions for many different target systems from any of several development systems. CISTI

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-19035# Gupta (Pradeep K.), Inc., Clifton Park, NY.
ANIMATED COMPUTER GRAPHICS MODELING OF ROLLING BEARING DYNAMICS Final Report, Apr. - Oct. 1991
Pradeep K. Gupta 18 Dec. 1991 29 p
(Contract F33615-91-C-2132)

(AD-A244375; G-112-TR; WL-TR-91-2129) Avail: NTIS HC/MF A03 CSCL 12/7

A two dimensional animated graphics model to simulate dynamic motions of the balls and cage, in a plane normal to the bearing axis and in an angular contact ball bearing, is developed. The graphics modeling is based on the primitives available under the Programmers Hierarchical Interactive Graphics System (PHIGS), which is now an international standard and it is supported on a wide range of computer systems. Appropriate transformations to produce the animated motion of bearing elements are derived from the dynamic solutions provided by the bearing dynamics computer code ADORE. Necessary modifications to ADORE to store all the required solutions in an ASCII data file are performed. This newly developed data file provides the interface between ADORE and the graphics model. Since PHIGS graphics standard is very widely supported, the graphics model developed herein can be used on a wide range of computer systems. For the present investigation an IBM-RISC/6000 work station is used. GRA

N92-19059# Karlsruhe Univ. (Germany, F.R.).
PROGRAMMING ENVIRONMENTS FOR HIGH LEVEL SCIENTIFIC PROBLEM SOLVING
Gerd Bohlender, Patrick Gaffney, and Elias Houstis 27 Sep. 1991 313 p Presented at the IFIP WG 2.5 Working Conference 6 held in Karlsruhe, Fed. Republic of Germany, 23-27 Sep. 1991
(Contract DAJA45-91-M-0319)
(AD-A243783; R/D-6809-EE-02) Avail: NTIS HC/MF A14 CSCL 12/5

Partial proceedings are presented from the conference. The paper is divided into the following areas: Introduction; Intelligent assistants; Mathematical Models; System and Tools, Systems Engineering I; Interaction and Visualization, System Engineering II. GRA

N92-19067# Howard Univ., Washington, DC.
ANALYSIS OF BLENDING ALGORITHMS IN COMPUTER GRAPHICS Final Report, 1 Sep. 1989 - 30 Sep. 1991
Ronald J. Leach Nov. 1991 22 p
(Contract DAAL03-89-G-0100)
(AD-A244279; ARO-26829.6-MA) Avail: NTIS HC/MF A03 CSCL 12/1

An important problem in solid modeling systems is the creation of surfaces that blend together two or more surfaces that describe objects. The purpose of blending is to create a single, more complex object. The blending surface itself is generally not of any special importance in this context but is intended to provide a smooth transition between the surfaces to be blended. The most complete results were obtained for the blending of surfaces that are described by either the explicit or implicit boundary representations. The final report provides a description of the results. GRA

N92-19073# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ESTABLISHING A METHODOLOGY FOR EVALUATION AND SELECTING COMPUTER AIDED SOFTWARE ENGINEERING TOOLS FOR A DEFINED SOFTWARE ENGINEERING ENVIRONMENT AT THE AIR FORCE INSTITUTE OF TECHNOLOGY SCHOOL OF ENGINEERING M.S. Thesis
Jody L. Mattingly Dec. 1991 179 p
(AD-A244016; AFIT/GCS/ENG/91D-13) Avail: NTIS HC/MF A09 CSCL 12/5

This thesis identifies the software engineering environment (SEE) as it exists at the Air Force Institute of Technology (AFIT) School of Engineering. It also describes the software process model employed and the software development methods presented as part of the curriculum. Based on this information, criteria was established to evaluate computer aided software engineering (CASE) tools being considered for integration into the SEE. Each criterion was weighted to indicate its importance when selecting CASE tools. The criteria were further used to establish a methodology to be used to evaluate and select the CASE tools under consideration as well as future tool candidates. GRA

N92-19074# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.
ANALYTICAL DERIVATION OF SOFTWARE FAILURE REGIONS Progress Report, Oct. 1990 - Sep. 1991
Timothy J. Shileall, John M. Bolchoz, and Rachel Griffin 9 Sep. 1991 34 p
(AD-A244021; NPS-CS-91-003) Avail: NTIS HC/MF A03 CSCL 12/5

This paper proposes an analytical method for deriving software failure regions, which are regions of the input space that are mapped to failures by specific faults. Previous studies have used empirical rather than analytical approaches to derive failure regions. A manual technique is presented and proven to produce the necessary and sufficient conditions of a fault being executed and leading to a failure. Semiautomated tools to assist in the manual technique are discussed, as is the use of failure regions in regression testing. GRA

N92-19082# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
IMPROVING ROYAL AUSTRALIAN AIR FORCE STRATEGIC AIRLIFT PLANNING BY APPLICATION OF A COMPUTER BASED MANAGEMENT INFORMATION SYSTEM M.S. Thesis
Neil A. Cooper Dec. 1991 293 p
(AD-A244077; AFIT/GIR/LSY/91D-4) Avail: NTIS HC/MF A13 CSCL 15/5

The purpose of this research was to propose a MIS to assist RAAF strategic operational airlift planning. The present manual approach suffers deficiencies in flexibility, consistency, and timeliness. Airlift planning was first analyzed and found to comprise activities of investigation, detailed static planning, implementation and dynamic planning, and review. Planning performance is measured by the effectiveness and efficiency of resulting airlift. Automation of planning functions was investigated, especially the routing and scheduling of airlift. USAF systems, including ADANS, were reviewed and applicability to the RAAF evaluated. A MIS is proposed that includes six development increments. It is expected to bring improvements in airlift effectiveness and efficiency through improved data management, better communications, and improved decision support. GRA

N92-19086# Texas Univ., El Paso. Dept. of Mathematical Sciences.
LOGIC PROGRAMMING AS AN INFERENCE ENGINE FOR NON-MONOTONIC REASONING Final Report, 15 Sep. 1989 - 14 Sep. 1991
Teodor C. Przymusinski 11 Nov. 1991 12 p
(Contract DAAL03-89-G-0117)
(AD-A244418; ARO-27079.11-MA-SAH) Avail: NTIS HC/MF A03 CSCL 12/5

Ten papers were published and two additional papers were accepted for publication. Moreover, four (4) papers are currently under preparation, including joint papers with W. Drabent, H. Przymusinska, L. Pereira, and D. S. Warren. Significant progress has been made towards both theoretical and algorithmic foundations of a non-monotonic reasoning system based on logic programming. An implementation of such a system, limited to circumscriptive theories, has been also completed. GRA

N92-19102# BBN Systems and Technologies Corp., Cambridge, MA.
SIMNET CVCC SIMNWT SIMULATION OF RADIO COMMUNICATION: A TESTBED FOR INVESTIGATION OF C3I TECHNOLOGY Report, Jul. 1990 - Jul. 1991
Arthur R. Pope, Ray Tomlinson, Jim Gonzalez, and Dan VanHook Jul. 1991 70 p
(Contracts MDA972-89-C-0060; MDA972-90-C-0061)
(AD-A244212; BBN-7352) Avail: NTIS HC/MF A04 CSCL 25/2

SIMNET is an advanced research project sponsored by the Defense Advanced Research Projects Agency (DARPA) in partnership with the United States Army. Currently in its seventh year, the goal of the program is to develop the technology to

build a large-scale network of interactive combat simulators. This simulated battlefield provides, for the first time, an opportunity for fully-manned platoon-, company-, and battalion-level units to fight force-on-force engagements against an opposing unit of similar composition. Furthermore, it does so in the context of a joint, combined arms environment with the complete range of command and control and combat service support elements essential to actual military operations. All of the elements that can affect the outcome of a battle are represented in this engagement, with victory likely to go to that unit which is able to plan, orchestrate, and execute their combined-arms battle operations better than their opponent. Whatever the outcome, combat units will benefit from this opportunity to practice collective, combined arms, joint war fighting skills at a fraction of the cost of an equivalent exercise in the field. GRA

N92-19103# BBN Systems and Technologies Corp., Cambridge, MA.
SIMNET CVCC SIMULATION OF THE SINCGARS RADIO SYSTEM SOFTWARE DESIGN DOCUMENT
Jul. 1991 86 p
(Contracts MDA972-89-C-0060; MDA972-90-C-0061)
(AD-A244215) Avail: NTIS HC/MF A05 CSCL 12/5

This BBN Software Design Document describes the SINCGARS radio simulation Computer Software Configuration Item (CSCI) for the SIMNET M1 tank simulator, as composed of Computer Software Components (CSCs) and Computer Software Units (CSUs). The SINCGARS radio simulator and radio interference unit (RIU) simulate the RT-1523 SINCGARS radio, either in manpack or vehicle-borne configuration. The system can reproduce the attenuation of a radio signal due to distance and intervening terrain, the effects of transmitter and receiver characteristics, radio interference and jamming, and detectability of emissions and source. They permit communication of both voice and data. GRA

N92-19112 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
SPECIFYING ITSEC FUNCTIONALITY CLASSES USING THE CLAIMS LANGUAGE
Richard Lampard Aug. 1991 38 p Sponsored by Dept. of Trade and Industry
(NPL-DITC-186/91; ISSN-0262-5369; ETN-92-91043) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

The specification of the hierarchical functionality classes of the Information Technology Security Evaluation Criteria (ITSEC) in terms of the claims language is attempted. By specifying the classes on a semiformal manner, they may be used in a security target for evaluations at levels E4 and E5. A few comments on the utility of the claims language are given in conclusions. ESA

N92-19114 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
SPECIFICATION OF THE TWO-WAY HANDSHAKE IN VDM
Richard Lampard Sep. 1991 12 p Sponsored by Dept. of Trade and Industry
(NPL-DITC-188/91; ISSN-0262-5369; ETN-92-91045) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

The feasibility of specifying a protocol based standard in terms of the specification language VDM is investigated. It aims to determine the suitability of VDM for such a task as compared with the more protocol oriented specification languages such as LOTOS or ESTELLE. ESA

N92-19115# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
EFFICIENT RAY SHOOTING AND HIDDEN SURFACE REMOVAL
Mark deBerg, D. Halperin, M. Overmars, Jack Snoeyink (British Columbia Univ., Vancouver.), and Marc vanKreveld Jul. 1991 29 p Sponsored by Commission of the European Communities and Netherlands Organization for Applied Scientific Research TNO
(RUU-CS-91-28; ISSN-0924-3275; ETN-92-91095) Avail: NTIS HC/MF A03

The ray shooting problem is studied for three special classes of polyhedral objects in space: axis parallel polyhedra, curtains (unbounded polygons with three edges, two of which are parallel to the z axis and extend downward to minus infinity) and fat horizontal triangles (triangles parallel to the z plane whose angles are greater than some fixed constant). For all three problems, structures are presented using O(n exp(2 + eta)) preprocessing, for any fixed eta greater than 0, with O(log n) query time. The general ray shooting problem in an arbitrary set of (possibly intersecting) triangles is studied. A structure that uses O(n exp(4 + eta)) preprocessing and has a query time of O(log n) is presented. As an application of the ray shooting structure for curtains, it is shown that the view of a set of (noninteresting) polyhedra with n edges in total can be computed in O(n exp(1 + eta) x the square root of k) time, where k is the size of the output, for any fixed eta greater than 0. This is the first output sensitive algorithm for this problem that does not need a depth order on the faces of the polyhedra. ESA

N92-19117# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TRANSLATION QUERIES FOR SETS OF POLYGONS
Mark deBerg, Hazel Everett, and Hubert Wagener (Technische Univ., Berlin, Germany, F.R.) Aug. 1991 25 p Sponsored in part by Netherlands Organization for Applied Scientific Research TNO
(Contract EEC-3075)
(RUU-CS-91-30; ISSN-0924-3275; ETN-92-91097) Avail: NTIS HC/MF A03

Let S be a set of m polygons in the plane with a total of n vertices. A translation order for S in direction d is an order on the polygons such that no collisions occur if the polygons are moved one by one to infinity in direction d according to this order. It is shown that S can be preprocessed in O(n log n) time into a data structure of size O(m) such that a translation order for a query direction can be computed in O(m) time, if it exists. It is also possible to test whether a translation order exists in O(log n) time with a structure that uses O(n) space. These results are achieved using new results on relative convex hulls and on embeddings with few vertices, which are interesting in their own right. Translation orders correspond to valid orders for hidden surface removal with the painter's algorithm. The technique can be used to generate displaying orders for polyhedral terrains. One of the advantages of the approach is that it can easily be adapted to handle perspective views within the same time and space bounds. ESA

N92-19118*# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
ISE: AN INTEGRATED SEARCH ENVIRONMENT. THE MANUAL
Lon-Chan Chu 5 Feb. 1992 133 p
(Contract NCC2-481; NAG1-613; NSF MIP-88-10584)
(NASA-CR-189926; NAS 1.26:189926; UILU-ENG-92-2202; CRHC-92-01) Avail: NTIS HC/MF A07 CSCL 09B

Integrated Search Environment (ISE), a software package that implements hierarchical searches with meta-control, is described in this manual. ISE is a collection of problem-independent routines to support solving searches. Mainly, these routines are core routines for solving a search problem and they handle the control of searches and maintain the statistics related to searches. By separating the problem-dependent and problem-independent components in ISE, new search methods based on a combination of existing methods can be developed by coding a single master control program. Further, new applications solved by searches can be developed by coding the problem-dependent parts and reusing the problem-independent parts already developed. Potential users of ISE are designers of new application solvers and new search algorithms, and users of experimental application solvers and search algorithms. The ISE is designed to be user-friendly

and information rich. In this manual, the organization of ISE is described and several experiments carried out on ISE are also described. Author

N92-19119*# Nebraska Univ., Lincoln.
DATA COMPRESSION USING ADAPTIVE TRANSFORM CODING. APPENDIX 1: ITEM 1 Ph.D. Thesis
Martin Christopher Rost Oct. 1988 194 p
(Grant NAG5-916)
(NASA-CR-189956; NAS 1.26:189956) Avail: NTIS HC/MF A09 CSCL 09B

Adaptive low-rate source coders are described in this dissertation. These coders adapt by adjusting the complexity of the coder to match the local coding difficulty of the image. This is accomplished by using a threshold driven maximum distortion criterion to select the specific coder used. The different coders are built using variable blocksized transform techniques, and the threshold criterion selects small transform blocks to code the more difficult regions and larger blocks to code the less complex regions. A theoretical framework is constructed from which the study of these coders can be explored. An algorithm for selecting the optimal bit allocation for the quantization of transform coefficients is developed. The bit allocation algorithm is more fully developed, and can be used to achieve more accurate bit assignments than the algorithms currently used in the literature. Some upper and lower bounds for the bit-allocation distortion-rate function are developed. An obtainable distortion-rate function is developed for a particular scalar quantizer mixing method that can be used to code transform coefficients at any rate. Author

N92-19135# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Computer Science.
A COMPENDIUM OF POSITION PAPERS FROM THE WORKSHOP ON ARCHITECTURES FOR FREE SPACE DIGITAL OPTICAL COMPUTING Final Report, 25 Jan. - 24 Nov. 1991
Miles Murdocca 24 Nov. 1991 54 p Workshop held in Vail, CO, 28-30 Jan. 1991
(Grant AF-AFOSR-0334-91; AF Proj. 2305)
(AD-A243855; AFOSR-91-1001TR) Avail: NTIS HC/MF A04 CSCL 12/6

On January 28 to 30, 1991, a workshop on architectures for free-space digital optical computing was held at the Holiday Inn Chateau Vail in Vail, Colorado. The workshop was initiated by Alan Craig of the Air Force Office of Scientific Research and was organized with Miles Murdocca (Rutgers University) and Michael Prise (AT and T Bell Labs). The purpose of the workshop was to bring together a panel of distinguished contributors to the field, identify current directions and discuss the future of the field. The emphasis of the workshop was on overall system architectures. Since systems depend on devices and optics, a number of contributors in these areas were invited both to provide a perspective on implementations and to learn what additional progress is necessary in order to implement systems that are either competitive or that complement future digital electronic systems. GRA

N92-19180# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ENHANCED ANIMATION OF PARALLEL ALGORITHMS, VOLUME 1 M.S. Thesis
Michael D. Lack Dec. 1991 131 p
(AD-A244046; AFIT/GCS/ENG/91D-11-Vol-1) Avail: NTIS HC/MF A07 CSCL 12/5

Algorithm animation is a visualization method used to enhance understanding of the functioning of an algorithm or program. Visualization is used for many purposes, including education, algorithm research, performance analysis, and program debugging. This research, which follows from previous work, examines algorithm animation requirements for the various visualization purposes and extends the capabilities of an existing facility, the AFIT Algorithm Animation Research Facility (AAARF). The structure of AAARF is summarized and its visualization capabilities presented, analyzed and compared with other similar packages. This research focuses on the parallel data requirements of the AAARF users, and the meaningful display of large amounts of data. This paper discusses a series of refined animations suitable for a variety of purposes which are capable of conveying detailed information in a concise and timely manner and the development and implementation of a new performance animation type is presented. These animations are built upon pedagogical efforts in a classroom environment. To assist novice users in efficiently using AAARF, an expert system interface has been implemented to advise on optimizing environment configuration. Considerable effort has been devoted to porting AAARF to the X Windows environment and the lessons learned and progress made are discussed. GRA

N92-19201# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A STANDARDIZED SOFTWARE RELIABILITY MEASUREMENT METHODOLOGY M.S. Thesis
Joseph J. Stanko Dec. 1991 179 p
(AD-A244184; AFIT/GCE/ENG/91D-09) Avail: NTIS HC/MF A09 CSCL 12/5

Current Air Force practice is to perform Operational Test and Evaluation (OT and E) for each new weapons system. In support of this, Headquarters Air Force Operational Test and Evaluation Center (HQ AFOTEC) is responsible for measuring both suitability and effectiveness. While suitability is adequately measured, the current effort only addresses hardware effectiveness, or at best, system effectiveness. Since tools and metrics are in place for software suitability assessments related to OT and E (for example, software maintainability), there should be some effective way of measuring the operational effectiveness of software. Currently, HQ AFOTEC/LG5 has a data collection tool for collecting software failure data to analyze software maturity. This thesis proposes that the LG5 software maturity database could be used as the baseline for a software reliability metric that would map to the finite time OT and E environment. This study does not predict software reliability, nor does it attempt to define what constitutes reliable software. Instead, this study evaluates software reliability measurement mapped to finite OT and E time frames (i.e., failure per flight hour). This evaluation is conducted for several software reliability models, with two candidate models chosen based on the following criteria: predictive validity; capability; quality of assumptions; applicability to the finite-time environment; simplicity of design; diversity and applicability of output; and capability to use existing initial data. GRA

N92-19233# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FORMAL VERIFICATION OF DIGITAL LOGIC M.S. Thesis
Stuart L. Labovitz Dec. 1991 211 p
(AD-A243834; AFIT/GCE/ENG/91D-06) Avail: NTIS HC/MF A10 CSCL 12/5

The most widely used technique for checking the correctness of digital circuit designs is simulation. As the complexity of digital circuits has continued to grow, circuit designers have become unable to perform complete simulations of their integrated circuits. Formal hardware verification provides an alternative approach, performing a series of mathematical proofs in order to show that the construction of the circuit from its submodules will result in the intended overall circuit behavior. Papers by Barrow in 1983 and 1984 discuss a PROLOG-based hierarchical formal circuit verification system named VERIFY. AFIT VERIFY, a simple, experimental reverse-engineered version of Barrow's VERIFY system, was produced by Captain Kevin Sparks in 1991. Since that time, a new user interface has been added to the AFIT VERIFY system, as well as the capability to maintain a central repository of standard, previously verified parts. This thesis provides a detailed description of these and other improvements that have been made to Sparks's AFIT VERIFY system. GRA

N92-19246# Mei Associates, Inc., Lexington, MA.
DESIGNING AN ADVANCED INSTRUCTIONAL DESIGN ADVISOR: CONCEPTUAL FRAMEWORKS, VOLUME 5 Interim Report, Aug. 1989 - Feb. 1991
Robert M. Gagne, Robert D. Tennyson, and Dennis J. Gettman
Dec. 1991 63 p
(Contract F33615-88-C-0003)
(AD-A244061; AL-TP-1991-0017-Vol-5) Avail: NTIS HC/MF A04 CSCL 12/5

The Advanced Instructional Design Advisor is an R and D project being conducted by the Armstrong Laboratory Human Resources Directorate and is aimed at producing automated instructional design guidance for developers of computer-based instructional materials. The process of producing effective computer-based instructional materials is complex and time-consuming. Few experts exist to insure the effectiveness of the process. As a consequence, the Air Force is committed to providing its courseware developers with up-to-date guidance appropriate for the creation of computer-based instruction. The assistance should be provided in an integrated automated setting. This paper addresses design specifications for an instructional design advisor. Instructional System Development (ISD), artificial intelligence, and expert systems are discussed. GRA

N92-19247# BBN Systems and Technologies Corp., Cambridge, MA.
MULTIRAD Final Technical Report
Jun. 1991 32 p
(Contracts MDA972-89-C-0060; MDA972-89-C-0061)
(AD-A244211; BBN-7621) Avail: NTIS HC/MF A03 CSCL 12/5

This report describes a Simulation Network (SIMNET) project final report of the Multirad network software of the SIMNET hardware and software training system for vehicle crew training and operational training. GRA

N92-19256*# Arizona Univ., Tucson. Dept. of Computer Science.
THE JADE FILE SYSTEM Ph.D. Thesis
Herman Chung-Hwa Rao 15 Aug. 1991 132 p
(Contract NCC2-561; NSF CCR-88-11423; NSF NCR-90-05028)
(NASA-CR-189929; NAS 1.26:189929; TR-91-18) Avail: NTIS HC/MF A07 CSCL 09B

File systems have long been the most important and most widely used form of shared permanent storage. File systems in traditional time-sharing systems, such as Unix, support a coherent sharing model for multiple users. Distributed file systems implement this sharing model in local area networks. However, most distributed file systems fail to scale from local area networks to an internet. Four characteristics of scalability were recognized: size, wide area, autonomy, and heterogeneity. Owing to size and wide area, techniques such as broadcasting, central control, and central resources, which are widely adopted by local area network file systems, are not adequate for an internet file system. An internet file system must also support the notion of autonomy because an internet is made up by a collection of independent organizations. Finally, heterogeneity is the nature of an internet file system, not only because of its size, but also because of the autonomy of the organizations in an internet. The Jade File System, which provides a uniform way to name and access files in the internet environment, is presented. Jade is a logical system that integrates a heterogeneous collection of existing file systems, where heterogeneous means that the underlying file systems support different file access protocols. Because of autonomy, Jade is designed under the restriction that the underlying file systems may not be modified. In order to avoid the complexity of maintaining an internet-wide, global name space, Jade permits each user to define a private name space. In Jade's design, we pay careful attention to avoiding unnecessary network messages between clients and file servers in order to achieve acceptable performance. Jade's name space supports two novel features: (1) it allows multiple file systems to be mounted under one direction; and (2) it permits one logical name space to mount other logical name spaces. A prototype of Jade was implemented to examine and validate its design. The prototype consists of interfaces to the Unix File System, the Sun Network File System, and the File Transfer Protocol. Author

N92-19265# Argonne National Lab., IL.
A SUMMARY OF THE FLOWTRAN CODE
A. M. White Mar. 1990 49 p
(Contract W-31-109-eng-38)
(DE90-012588; ANL-FRA-166) Avail: NTIS HC/MF A03

This document will provide an introduction to the theory and use of FLOWTRAN Version 16.1 on the ANL VAX 8700 and CRAY XMP/14. Further information on the theory and usage can be found in the FLOWTRAN Manual, DPSTM-140 (Draft). This document will give a brief description of the thermal hydraulics limits system currently employed at the Savannah River Site. In this discussion, the flow path of data to and from the FLOWTRAN code will be given. The other codes involved in the limits calculation will also be briefly described. It will describe the methods employed in the thermal and hydraulics sections of the codes. The various correlations and solution schemes will be discussed briefly. This paper will also describe the FLOWTRAN input. To model an MK22 assembly, typically, about 1000 lines of input are required. This report will only give a brief summary of the requirements. For more detailed information, DPSTM-140 can be consulted. The final section will present a sample problem (used to determine the November 30 flow zone 1 limits for SRS reactors) which models a MK22 assembly. An appendix, which presents a sample design study, is also included. DOE

N92-19266# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
BINARY PROGRAMMING MODELS OF SPATIAL PATTERN RECOGNITION: APPLICATIONS IN REMOTE SENSING IMAGE ANALYSIS M.S. Thesis
Thomas G. Reed Dec. 1991 307 p
(AD-A243797; AFIT/GSO/ENS/91D-15) Avail: NTIS HC/MF A14 CSCL 12/5

The major purpose of this investigation was to implement subregion allocation objectives using a network model base on an existing subregion allocation binary programming model (Benabdallah and Wright (B&W), 1990), the ultimate goal being the application of subregion allocation concepts towards the spatial analysis of satellite imagery. The multi-objective aspects of subregion allocation can be accomplished via a network formulation, a formulation vastly simpler in complexity than the binary programming models previously used. Without a network programming package that could maintain integral flows, deriving the solution was a tiresome task for the user. Nonetheless, several new concepts and advantages to using networks were discussed and demonstrated to the degree possible. Spatial analysis could benefit from applying a modified version of the B&W model to the pixels of satellite imagery in a way which takes advantage of the inherent contiguity of natural terrain subregions. Trending and forecasting of subregion changes, tasks that rely on acquiring data in a consistent manner image after image, could benefit due to the fact that major spatial characteristics of subregions could be extracted, and minor spatial changes could be removed. GRA

N92-19267# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A DYNAMIC COMPUTER GRAPHICS MODEL OF SATELLITE ORBITS FOR USE IN INSTRUCTION AND ANALYSIS M.S. Thesis
John P. Anton Dec. 1991 87 p
(AD-A243798; AFIT/GSO/ENS/91D-01) Avail: NTIS HC/MF A05 CSCL 12/5

A computer model of satellite orbits was developed to illustrate difficult orbital concepts. It was also designed to analyze the positions of a satellite constellation with respect to locations on the earth as an aid to analysts. A literature review revealed that existing methods relay on drawings, expensive computers, or are satellite system specific, but that it would be possible to develop

such a tool for an IMB-compatible personal computer using the Pascal language. Model capabilities selected included (1) a menu driven user interface; (2) a screen display showing satellite locations, ground track, and an earth map in one of three reference frames; and (3) three file output formats allowing satellite position information to be dumped to ASCII files for further analysis. Model validation was performed to ensure that the satellites are accurately propagated in their orbits from the NORAD two-line element sets used as an input to the model. The model should be used in instruction to bring the dynamic nature of satellite orbits to life and add a memorable perspective on the nature of various constellations. In analysis, it should be used where convenience, availability, and ease of use are vital. GRA

N92-19268# Battelle Columbus Labs., OH.
A REVIEW OF HARDWARE AND SOFTWARE TECHNOLOGY INCLUDED WITHIN THE ELECTRONIC INFORMATION DELIVERY SYSTEM (EIDS) Final Report, Jun. - Sep. 1991
Jerrel K. Yates Nov. 1991 66 p
(Contract DAAL03-86-D-0001; DA Proj. 2Q2-63007-A-794)
(AD-A243826; ARI-RN-92-09) Avail: NTIS HC/MF A04 CSCL 12/5

For this report, the Electronic Information Delivery System (EIDS) hardware and its associated software, Authoring Software Systems of Interactive Simulation and Training (ASSIST), were examined. The purpose of the examination was to produce EIDS supplementary documentation with the associated EIDS storybook records. EIDS, with its integral video-disc player and branching capacity, is a medium capable of presenting learning tasks that span the continuum from concrete to abstract. However, the EIDS ASSIST does not provide complete examples or program demonstrations. Without additional assistance, the user's initial experience with EIDS is cumbersome at best. Current documentation needs complete examples (paper and program) that include the full complement of media and programming functions available. The examples should demonstrate the production of tests that include fill-in-the-blank and multiple-choice questions and questions with several correct responses. A thoroughly tested example with feedback will provide the user with an experience of the interactive capabilities of EIDS. GRA

N92-19305# Baylor Coll. of Medicine, Houston, TX.
A STUDY OF NEURONAL PROPERTIES, SYNAPTIC PLASTICITY, AND NETWORK INTERACTIONS USING A COMPUTER RECONSTITUTED NEURONAL NETWORK DERIVED FROM FUNDAMENTAL BIOPHYSICAL PRINCIPLES
David C. Tam 15 Dec. 1991 69 p
(Contract N00014-90-J-1353)
(AD-A244251; BCM-NS-CNS-91-002) Avail: NTIS HC/MF A04 CSCL 12/5

A standalone executable computer program of the neural simulator MacNeuron is developed on the Macintosh IIci and Quadra computers. Two versions are available: one runs on the Macintosh II series computer with the math coprocessor installed, the other runs without the math coprocessor. The version with the math coprocessor executes faster than the one without the coprocessor. The current version (version 0.3 release) allows users to build a compartmental neuron, simulate the generation of action potentials and record any variables for graphical display. The variables include voltage, time and ionic concentration, etc. Each of these variables can be plotted on the graphical charts. A Tutorial Manual and a User's Guide Manual are written describing the simulator, its run-time environment and a guide to use the neural simulator program. The current version of MacNeuron implemented the numerical algorithms for driving the neural simulator. It also included the plotting routines for displaying the simulation results. The current version uses a window-based user-interface for building a network of neuron. GRA

N92-19335# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN ALGORITHM FOR ROBUST EIGENSTRUCTURE ASSIGNMENT USING THE LINEAR QUADRATIC REGULATOR M.S. Thesis
Thomas C. Huckabone Dec. 1991 119 p
(AD-A244267; AFIT/GAE/ENY/91D-7) Avail: NTIS HC/MF A06 CSCL 12/5

The Linear Quadratic Regulator (LQR) can guarantee a robust closed loop eigenstructure for full state feedback. The algorithm developed here takes advantage of the stability guarantees of LQR to achieve an eigenstructure close to desired but within the allowable region of LQR. The algorithm selects the LQR weighting matrices, Q and R, that minimize the distance between the elements of the desired and LQR achievable eigenstructures. The minimization is accomplished by using a simplex based optimization routine. Specific weightings placed on the elements of the desired eigenstructure define the relative importance of each element. The algorithm is programmed in FORTRAN and is designed to be run from the software package MATLAB. Two examples are examined to illustrate the use of the program, including a helicopter flight control system. The results show that this algorithm is a valid technique for achieving robust eigenstructure assignment with full state feedback. GRA

N92-19343# Colorado Univ., Boulder.
PARALLEL GLOBAL OPTIMIZATION: NUMERICAL METHODS, DYNAMIC SCHEDULING METHODS, AND APPLICATION TO MOLECULAR CONFIGURATION
Richard H. Byrd, Elizabeth Eskow, Robert B. Schnabel, and Sharon L. Smith Oct. 1991 21 p
(Contract DAAL03-91-G-0151)
(AD-A244423; ARO-24923.12-MA) Avail: NTIS HC/MF A03 CSCL 12/3

Global optimization problems are computationally extensive problems that arise in many important applications. The solution of very large practical global optimization problems, which may have thousands of variables and huge numbers of local minimizers, is not yet possible. It will require efficient numerical algorithms that take advantage of the properties of the particular application, as well as efficient utilization of the fastest available computers, which will almost certainly be highly parallel machines. This paper summarizes our research efforts in this direction. First, we describe general purpose adaptive, asynchronous parallel stochastic global optimization methods that we have developed. Second, we describe several alternative dynamic scheduling algorithms that are required to control such dynamic parallel algorithms on distributed memory multiprocessors, and compare their performance in the context of our parallel global optimization methods. Third, we discuss the application and refinement of these methods to global optimization problems arising from the structural optimization of chemical molecules, and present preliminary computational results on some problems with between 15 and 100 variables. This work includes the development of new algorithmic features that are motivated by the molecular configuration problem but are applicable to a wider class of large scale, partially separable global optimization problems. GRA

N92-19362*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
EXPERT SYSTEM VERIFICATION AND VALIDATION GUIDELINES/WORKSHOP TASK. DELIVERABLE NO. 1: ES V/V GUIDELINES
Scott W. French (International Business Machines Corp., Houston, TX.) 3 Sep. 1991 39 p
(Contract NCC9-16)
(NASA-CR-189941; NAS 1.26:189941) Avail: NTIS HC/MF A03 CSCL 09B

The goals are to show that verifying and validating a software system is a required part of software development and has a direct impact on the software's design and structure. Workshop tasks are given in the areas of statistics, integration/system test,

unit and architectural testing, and a traffic controller problem.
Author

N92-19380*# Alabama Univ., Huntsville.
A COMPUTER CODE FOR MULTIPHASE ALL-SPEED TRANSIENT FLOWS IN COMPLEX GEOMETRIES. MAST VERSION 1.0 Final Report, period ending 10 Sep. 1991
C. P. Chen, Y. Jiang, Y. M. Kim, and H. M. Shang Oct. 1991 86 p
(Grant NAG8-092)
(NASA-CR-190032; NAS 1.26:190032) Avail: NTIS HC/MF A05 CSCL 09B

The operation of the MAST code, which computes transient solutions to the multiphase flow equations applicable to all-speed flows, is described. Two-phase flows are formulated based on the Eulerian-Lagrange scheme in which the continuous phase is described by the Navier-Stokes equation (or Reynolds equations for turbulent flows). Dispersed phase is formulated by a Lagrangian tracking scheme. The numerical solution algorithms utilized for fluid flows is a newly developed pressure-implicit algorithm based on the operator-splitting technique in generalized nonorthogonal coordinates. This operator split allows separate operation on each of the variable fields to handle pressure-velocity coupling. The obtained pressure correction equation has the hyperbolic nature and is effective for Mach numbers ranging from the incompressible limit to supersonic flow regimes. The present code adopts a nonstaggered grid arrangement; thus, the velocity components and other dependent variables are collocated at the same grid. A sequence of benchmark-quality problems, including incompressible, subsonic, transonic, supersonic, gas-droplet two-phase flows, as well as spray-combustion problems, were performed to demonstrate the robustness and accuracy of the present code. Author

N92-19387# Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin (Germany, F.R.).
METHOD OF SOFTWARE ASSESSMENT AND CERTIFICATION
H. L. Hausen, N. Cacutalua, and D. Welzel 1991 195 p
(PB92-114685; GMD-571) Copyright Avail: NTIS HC/MF A09 CSCL 09B

For understanding and modeling the software assessment and certification process, a number of problem domains and their interactions have to be considered. As a kernel for an assessment and certification method, models for software characteristics and metrics for software products and for software engineering processes are developed and applied to selected examples in order to show their applicability. An interaction of the particular models is outlined by a predicate specification of an Assessment and Certification Advisor, which might be considered as an abstract method of assessing and certifying software systems. Author

N92-19393# Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin (Germany, F.R.).
FLEXIBILITY IN AN OBJECT-ORIENTED GRAPHICS KERNEL BY OVERRIDING INTERNAL METHODS
P. Wisskirchen 1991 23 p
(PB92-114776; GMD-568) Copyright Avail: NTIS HC/MF A03 CSCL 09B

The requirements to achieve a flexible graphics kernel are discussed. It is shown that an object oriented approach can be customized to various needs of applications without giving up the idea of a hidden internal implementation. The basic principles are discussed alongside an example where the application is a small graphics editor and the kernel is a multi-level graphics system. Implications relative to future object-oriented graphics standards are mentioned. Author

N92-19420*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PROCEEDINGS OF THE FIFTEENTH ANNUAL SOFTWARE ENGINEERING WORKSHOP
Nov. 1990 618 p Workshop held in Greenbelt, MD, 28-29 Nov. 1990
(NASA-TM-105506; SEL-90-006; NAS 1.15:105506) Avail: NTIS HC/MF A99 CSCL 09B

The Software Engineering Laboratory (SEL) is an organization sponsored by GSFC and created for the purpose of investigating the effectiveness of software engineering technologies when applied to the development of applications software. The goals of the SEL are: (1) to understand the software development process in the GSFC environment; (2) to measure the effect of various methodologies, tools, and models on this process; and (3) to identify and then to apply successful development practices. Fifteen papers were presented at the Fifteenth Annual Software Engineering Workshop in five sessions: (1) SEL at age fifteen; (2) process improvement; (3) measurement; (4) reuse; and (5) process assessment. The sessions were followed by two panel discussions: (1) experiences in implementing an effective measurement program; and (2) software engineering in the 1980's. A summary of the presentations and panel discussions is given. For individual titles, see N92-19421 through N92-19435.

N92-19421*# Maryland Univ., College Park. Dept. of Computer Science.
TOWARDS A MATURE MEASUREMENT ENVIRONMENT: CREATING A SOFTWARE ENGINEERING RESEARCH ENVIRONMENT
Victor R. Basili *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 p 1-42 (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Software engineering researchers are building tools, defining methods, and models; however, there are problems with the nature and style of the research. The research is typically bottom-up, done in isolation so the pieces cannot be easily logically or physically integrated. A great deal of the research is essentially the packaging of a particular piece of technology with little indication of how the work would be integrated with other prices of research. The research is not aimed at solving the real problems of software engineering, i.e., the development and maintenance of quality systems in a productive manner. The research results are not evaluated or analyzed via experimentation or refined and tailored to the application environment. Thus, it cannot be easily transferred into practice. Because of these limitations we have not been able to understand the components of the discipline as a coherent whole and the relationships between various models of the process and product. What is needed is a top down experimental, evolutionary framework in which research can be focused, logically and physically integrated to produce quality software productively, and evaluated and tailored to the application environment. This implies the need for experimentation, which in turn implies the need for a laboratory that is associated with the artifact we are studying. This laboratory can only exist in an environment where software is being built, i.e., as part of a real software development and maintenance organization. Thus, we propose that Software Engineering Laboratory (SEL) type activities exist in all organizations to support software engineering research. We describe the SEL from a researcher's point of view, and discuss the corporate and government benefits of the SEL. The discussion focuses on the benefits to the research community. Author

N92-19422*# Computer Sciences Corp., Lanham, MD.
IMPACT OF A PROCESS IMPROVEMENT PROGRAM IN A PRODUCTION SOFTWARE ENVIRONMENT: ARE WE ANY BETTER?
Gerard H. Heller and Gerald T. Page *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 26 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

For the past 15 years, Computer Sciences Corporation (CSC) has participated in a process improvement program as a member of the Software Engineering Laboratory (SEL), which is sponsored by GSFC. The benefits CSC has derived from involvement in this program are analyzed. In the environment studied, it shows that

improvements were indeed achieved, as evidenced by a decrease in error rates and costs over a period in which both the size and the complexity of the developed systems increased substantially. The principles and mechanics of the process improvement program, the lessons CSC has learned, and how CSC has capitalized on these lessons are also discussed. Author

N92-19423*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TOWARDS UNDERSTANDING SOFTWARE: 15 YEARS IN THE SEL
Frank McGarry and Rose Pajerski *In its* Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 32 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

For 15 years, the Software Engineering Laboratory (SEL) at GSFC has been carrying out studies and experiments for the purpose of understanding, assessing, and improving software, and software processes within a production software environment. The SEL comprises three major organizations: (1) the GSFC Flight Dynamics Division; (2) the University of Maryland Computer Science Department; and (3) the Computer Sciences Corporation Flight Dynamics Technology Group. These organizations have jointly carried out several hundred software studies, producing hundreds of reports, papers, and documents: all describing some aspect of the software engineering technology that has undergone analysis in the flight dynamics environment. The studies range from small controlled experiments (such as analyzing the effectiveness of code reading versus functional testing) to large, multiple-project studies (such as assessing the impacts of Ada on a production environment). The key findings that NASA feels have laid the foundation for ongoing and future software development and research activities are summarized. Author

N92-19424*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A FRAMEWORK FOR ASSESSING THE ADEQUACY AND EFFECTIVENESS OF SOFTWARE DEVELOPMENT METHODOLOGIES
James D. Arthur and Richard E. Nance *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 47 p (For primary document see N92-19420 10-61)
(Contract N60921-83-G-A165-B003-4)
Avail: NTIS HC/MF A99 CSCL 09B

Tools, techniques, environments, and methodologies dominate the software engineering literature, but relatively little research in the evaluation of methodologies is evident. This work reports an initial attempt to develop a procedural approach to evaluating software development methodologies. Prominent in this approach are: (1) an explication of the role of a methodology in the software development process; (2) the development of a procedure based on linkages among objectives, principles, and attributes; and (3) the establishment of a basis for reduction of the subjective nature of the evaluation through the introduction of properties. An application of the evaluation procedure to two Navy methodologies has provided consistent results that demonstrate the utility and versatility of the evaluation procedure. Current research efforts focus on the continued refinement of the evaluation procedure through the identification and integration of product quality indicators reflective of attribute presence, and the validation of metrics supporting the measure of those indicators. The consequent refinement of the evaluation procedure offers promise of a flexible approach that admits to change as the field of knowledge matures. In conclusion, the procedural approach presented in this paper represents a promising path toward the end goal of objectively evaluating software engineering methodologies. Author

N92-19425*# Houston Univ., Clear Lake, TX.
A METHOD FOR TAILORING THE INFORMATION CONTENT OF A SOFTWARE PROCESS MODEL
Sharon Perkins and Mark B. Arend (McDonnell-Douglas Space Systems Co., Houston, TX.) *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 32 p Previously announced as N91-13097 (For primary document see N92-19420 10-61)
(Contract NCC9-16)
Avail: NTIS HC/MF A99 CSCL 09B

The framework is defined for a general method for selecting a necessary and sufficient subset of a general software life cycle's information products, to support new software development process. Procedures for characterizing problem domains in general and mapping to a tailored set of life cycle processes and products is presented. An overview of the method is shown using the following steps: (1) During the problem concept definition phase, perform standardized interviews and dialogs between developer and user, and between user and customer; (2) Generate a quality needs profile of the software to be developed, based on information gathered in step 1; (3) Translate the quality needs profile into a profile of quality criteria that must be met by the software to satisfy the quality needs; (4) Map the quality criteria to a set of accepted processes and products for achieving each criterion; (5) select the information products which match or support the accepted processes and product of step 4; and (6) Select the design methodology which produces the information products selected in step 5. Author

N92-19426*# Raytheon Co., Tewksbury, MA. Missile Systems Div.
SOFTWARE TECHNOLOGY INSERTION: A STUDY OF SUCCESS FACTORS
Tom Lydon *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 25 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Managing software development in large organizations has become increasingly difficult due to increasing technical complexity, stricter government standards, a shortage of experienced software engineers, competitive pressure for improved productivity and quality, the need to co-develop hardware and software together, and the rapid changes in both hardware and software technology. The 'software factory' approach to software development minimizes risks while maximizing productivity and quality through standardization, automation, and training. However, in practice, this approach is relatively inflexible when adopting new software technologies. The methods that a large multi-project software engineering organization can use to increase the likelihood of successful software technology insertion (STI), especially in a standardized engineering environment, are described. Author

N92-19427*# TRW Defense and Space Systems Group, Redondo Beach, CA.
PRAGMATIC QUALITY METRICS FOR EVOLUTIONARY SOFTWARE DEVELOPMENT MODELS
Walker Royce *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 31 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Due to the large number of product, project, and people parameters which impact large custom software development efforts, measurement of software product quality is a complex undertaking. Furthermore, the absolute perspective from which quality is measured (customer satisfaction) is intangible. While we probably can't say what the absolute quality of a software product is, we can determine the relative quality, the adequacy of this quality with respect to pragmatic considerations, and identify good and bad trends during development. While no two software engineers will ever agree on an optimum definition of software quality, they will agree that the most important perspective of software quality is its ease of change. We can call this flexibility, adaptability, or some other vague term, but the critical characteristic of software is that it is soft. The easier the product is to modify, the easier it is to achieve any other software quality perspective. This paper presents objective quality metrics derived from consistent lifecycle perspectives of rework which, when used in

concert with an evolutionary development approach, can provide useful insight to produce better quality per unit cost/schedule or to achieve adequate quality more efficiently. The usefulness of these metrics is evaluated by applying them to a large, real world, Ada project. Author

N92-19428*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL'S REAL-TIME WEATHER PROCESSOR PROJECT (RWP) METRICS AND OBSERVATIONS AT SYSTEM COMPLETION
Robert E. Loesh, Robert A. Conover, and Shan Malhotra *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 26 p (For primary document see N92-19420 10-61)
(Contract NAS7-918)
Avail: NTIS HC/MF A99 CSCL 09B

As an integral part of the overall upgraded National Airspace System (NAS), the objective of the Real-Time Weather Processor (RWP) project is to improve the quality of weather information and the timeliness of its dissemination to system users. To accomplish this, an RWP will be installed in each of the Center Weather Service Units (CWSUs), located in 21 of the 23 Air Route Traffic Control Centers (ARTCCs). The RWP System is a prototype system. It is planned that the software will be GFE and that production hardware will be acquired via industry competitive procurement. The ARTCC is a facility established to provide air traffic control service to aircraft operating on Instrument Flight Rules (IFR) flight plans within controlled airspace, principally during the en route phase of the flight. Covered here are requirement metrics, Software Problem Failure Reports (SPFRs), and Ada portability metrics and observations. Author

N92-19429*# Mitre Corp., McLean, VA.
EARLY EXPERIENCES BUILDING A SOFTWARE QUALITY PREDICTION MODEL
W. W. Agresti, W. M. Evanco, and M. C. Smith *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 24 p Sponsored in part by MITRE Corp., McLean, VA (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Early experiences building a software quality prediction model are discussed. The overall research objective is to establish a capability to project a software system's quality from an analysis of its design. The technical approach is to build multivariate models for estimating reliability and maintainability. Data from 21 Ada subsystems were analyzed to test hypotheses about various design structures leading to failure-prone or unmaintainable systems. Current design variables highlight the interconnectivity and visibility of compilation units. Other model variables provide for the effects of reusability and software changes. Reported results are preliminary because additional project data is being obtained and new hypotheses are being developed and tested. Current multivariate regression models are encouraging, explaining 60 to 80 percent of the variation in error density of the subsystems. Author

N92-19430*# Maryland Univ., College Park. Dept. of Computer Science.
BIAS AND DESIGN IN SOFTWARE SPECIFICATIONS
Pablo A. Straub and Marvin V. Zelkowitz *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 25 p Sponsored in part by ODEPLAN Chile; and the Catholic Univ. of Chile (For primary document see N92-19420 10-61)
(Grant NsG-5123)
Avail: NTIS HC/MF A99 CSCL 09B

Implementation bias in a specification is an arbitrary constraint in the solution space. Presented here is a model of bias in software specifications. Bias is defined in terms of the specification process and a classification of the attributes of the software product. Our definition of bias provides insight into both the origin and the consequences of bias. It also shows that bias is relative and essentially unavoidable. Finally, we describe current work on defining a measure of bias, formalizing our model, and relating bias to software defects. Author

N92-19431*# Computer Sciences Corp., Lanham, MD.
SEL Ada REUSE ANALYSIS AND REPRESENTATIONS
Rush Kester *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 31 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Overall, it was revealed that the pattern of Ada reuse has evolved from initial reuse of utility components into reuse of generalized application architectures. Utility components were both domain-independent utilities, such as queues and stacks, and domain-specific utilities, such as those that implement spacecraft orbit and attitude mathematical functions and physics or astronomical models. The level of reuse was significantly increased with the development of a generalized telemetry simulator architecture. The use of Ada generics significantly increased the level of verbatum reuse, which is due to the ability, using Ada generics, to parameterize the aspects of design that are configurable during reuse. A key factor in implementing generalized architectures was the ability to use generic subprogram parameters to tailor parts of the algorithm embedded within the architecture. The use of object oriented design (in which objects model real world entities) significantly improved the modularity for reuse. Encapsulating into packages the data and operations associated with common real world entities creates natural building blocks for reuse. Author

N92-19432*# Reifer Consultants, Inc., Torrance, CA.
REUSE METRICS AND MEASUREMENT: A FRAMEWORK
Donald J. Reifer *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 20 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

The lessons learned and experience gleaned are described by those who have started to implement the reuse metrics and measurement framework used in controlling the development of common avionics and software for its affiliated aircraft programs. The framework was developed to permit the measurement of the long term cost/benefits resulting from the creation and use of Reusable Software Objects (RSOs). The framework also monitors the efficiency and effectiveness of the Software Reuse Library (SRL). The metrics and measurement framework is defined which was established to allow some determinations and findings to be made relative to software reuse. Seven criteria are discussed which were used to guide the establishment of the proposed reuse framework. Object recapture and creation metrics are explained along with their normalized use in effort, productivity, and quality determination. A single and multiple reuse instance version of a popular cost model is presented which uses these metrics and the measurement scheme proposed to predict the software effort and duration under various reuse assumptions. Studies in using this model to predict actuals taken from the RCI data base of over 1000 completed projects is discussed. Author

N92-19433*# IBM Federal Systems Div., Houston, TX.
COST AND QUALITY PLANNING FOR LARGE NASA PROGRAMS
Kyle Y. Rone *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 25 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

The Software Cost and Quality Engineering methodology developed over the last two decades at IBM Federal Sector Div. is used to plan the NASA Space Station Data Management System (DMS). An ongoing project to capture this methodology, which is built on a foundation of experiences and lessons learned, has resulted in the development of a PC-based tool that integrates cost and quality forecasting methodologies and data in a consistent manner. This tool, Software Cost and Quality Engineering Starter

Set (SCQESS), is being used to assist in the DMS costing exercises. At the same time, DMS planning serves as a forcing function and provides a platform for the continuing, iterative development, calibration, and validation and verification of SCQESS. The data that forms the cost and quality engineering data base is derived from more than 17 years of development of NASA Space Shuttle software, ranging from low criticality, low complexity support tools to highly complex and highly critical onboard software. Author

N92-19434*# Syracuse Univ., NY. Dept. of Electrical and Computer Engineering.
EFFECT OF FORMAL SPECIFICATIONS ON PROGRAM COMPLEXITY AND RELIABILITY: AN EXPERIMENTAL STUDY
Amrit L. Goel and Swarupa N. Sahoo *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 29 p (For primary document see N92-19420 10-61)
(Contract NAG1-806; DAKF11-89-C-0038)
Avail: NTIS HC/MF A99 CSCL 09B

The results are presented of an experimental study undertaken to assess the improvement in program quality by using formal specifications. Specifications in the Z notation were developed for a simple but realistic antimissile system. These specifications were then used to develop 2 versions in C by 2 programmers. Another set of 3 versions in Ada were independently developed from informal specifications in English. A comparison of the reliability and complexity of the resulting programs suggests the advantages of using formal specifications in terms of number of errors detected and fault avoidance. Author

N92-19435*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN ANALYSIS OF DEFECT DENSITIES FOUND DURING SOFTWARE INSPECTIONS
John C. Kelly, Joseph S. Sherif (California State Univ., Fullerton.), and Jonathan Hops *In* NASA. Goddard Space Flight Center, Proceedings of the 15th Annual Software Engineering Workshop Nov. 1990 35 p (For primary document see N92-19420 10-61)
Avail: NTIS HC/MF A99 CSCL 09B

Software inspection is a technical evaluation process for finding and removing defects in requirements, design, code, and tests. Detailed data was collected during the first three years of experience at JPL on 203 inspections. Statistics are discussed for this set of inspections. Included, on a per inspection basis, are averages of: staff time expended, pages covered, major defects found, minor defects found, and inspection team size. Analysis of variance showed a significantly higher density of defects during requirements inspections. It was also observed, that the defect densities found decreased exponentially as the work products approached the coding phase. Increasing the pace of the inspection meeting decreased the density of defects found. This relationship was observed to hold for both major and minor defect densities, although it was more pronounced for minor defects. Guidelines are provided for conducting successful software inspections based upon three years of JPL experience. Author

N92-19444*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
USER'S GUIDE TO RESIN INFUSION SIMULATION PROGRAM IN THE FORTRAN LANGUAGE
Mark H. Weideman, Vince H. Hammond, and Alfred C. Loos Jan. 1992 87 p
(Grant NAG1-343)
(NASA-CR-189928; CCMS-92-03; VPI-E-92-04; NAS 1.26:189928)
Avail: NTIS HC/MF A05 CSCL 09B

RTMCL is a user friendly computer code which simulates the manufacture of fabric composites by the resin infusion process. The computer code is based on the process simulation model described in reference 1. Included in the user's guide is a detailed step by step description of how to run the program and enter and modify the input data set. Sample input and output files are included along with an explanation of the results. Finally, a complete listing of the program is provided. Author

N92-19453# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN INVESTIGATION OF A DESIGN FOR A FINITE-DIFFERENCE TIME DOMAIN (FDTD) HARDWARE ACCELERATOR M.S. Thesis
James R. Marek Dec. 1991 119 p
(AD-A243823; AFIT/GE/ENG/91D-38) Avail: NTIS HC/MF A06 CSCL 12/6

This study investigated increasing the speed of Finite-Difference Time Domain (FDTD) cell calculations through a special purpose architecture using Very Large Scale Integration (VLSI). These FDTD cell equations model inhomogeneous, isotropic, lossy magnetic and dielectric materials. Special attention was given to simplicity and performance, using the fastest components generally available in AFIT VLSI programs, while attempting to minimize component count. A VHSIC Hardware Description Language simulation of the proposed chip established design feasibility and provided performance estimates: 350 ns to generate the first cell value, 200 ns thereafter (30 MFLOPS maximum double-precision). This study also implemented boundary conditions in hardware as well. No new hardware was designed; instead, the algorithm was translated into microcode for use by the AFIT Floating Point Application Specific Processor. The first boundary value is computed in 850ns, with successive results calculated every 300 ns thereafter (43 MFLOPS maximum double-precision). Standard FDTD FORTRAN codes were run on a SPARC2 workstation and execution times compared to modified codes simulating the implementation of the above hardware. On a 66 cubic cell free-space computational domain, these chips reduced total FDTD code execution time by a factor of 4.9, and cell and boundary calculation time by a factor of 9.5. GRA

N92-19465# BBN Systems and Technologies Corp., Cambridge, MA.
SIMNET CVCC SIMNET SIMULATION OF RADIO COMMUNICATION: A TESTBED FOR INVESTIGATION OF C3I TECHNOLOGY. APPENDIX C: RADIO PERFORMANCE MONITOR
Jul. 1991 26 p
(Contracts MDA972-89-C-0060; MDA972-90-C-0061)
(AD-A244213; BBN-7352-App-C) Avail: NTIS HC/MF A03 CSCL 25/2

The radio performance monitor (radmon) is a program for monitoring and analyzing the performance of the SINCGARS radio simulation for SIMNET. Radmon monitors traffic on the simulation network and records information broadcast by the SINCGARS radio simulator hosts concerning every important state change of every simulated radio. For example, when the channel selection knob on a radio is turned to a different channel, the SINCGARS radio simulator broadcasts a Transmitter PDU giving the new frequency selection for that radio. Radmon receives the transmission and records which radio changed state, the nature of the change, and the time at which the change occurred. Radmon maintains a running history of these state changes for each radio. The information the random records can be saved in a file and subsequently restored from that file. Radmon allows the user to browse through the recorded data to examine interactions in detail. The recorded data can also be summarized to show channel utilization, radio utilization, and other statistics of radio activity. The collected information can be presented in several ways. A stripchart display shows the activity of radios as a function of time. A connectivity map shows the communication paths that are usable. A status display shows the detailed state of individual radios. Author (GRA)

N92-19533# Technische Univ., Eindhoven (Netherlands).
A GENERALIZATION OF FAULT-TOLERANCE BASED ON MASKING Ph.D. Thesis
Thijs Krol 1991 232 p Prepared in cooperation with Philips Gloeilampenfabrieken N.V., Eindhoven, Netherlands
(ETN-92-90896) Copyright Avail: NTIS HC/MF A11

The generalization of a particular method called 'masking', which is used for improving the reliability of digital systems, such as computer systems, is addressed. A method which makes the proper functioning of a fault tolerant system independent of an unreliable world is presented. For the latter purpose an effective interactive consistency algorithm is developed. Drawbacks in reliability improvement of the class of fault tolerant architectures based on masking are addressed by reducing a fault tolerant digital system based on masking to a set of coupled Moore machines and identifying the critical data transfers. The classical masking concept, the N-modular redundancy scheme, is generalized by replacing the majority vote, which is the key of this method, by the decoder function of an error correcting code. The result is called 'generalized masking'. A number of methods to solve the 'input problem', based on an algorithm similar to the interactive consistency algorithms, are presented. ESA

N92-19584# Technische Univ., Delft (Netherlands).
REFERENCE MODELS FOR INDUSTRIAL AUTOMATION Ph.D. Thesis
Henri Michel Boehms 1991 208 p Sponsored by Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek
(ISBN-90-9004205-9; ETN-92-90885) Copyright Avail: NTIS HC/MF A10

Computer Integrated Manufacturing (CIM) is addressed. To analyze existing ideas about a general, open and reusable CIM reference architecture, a descriptive CIM framework was developed in which different dimensions in modeling CIM are identified which are addressed by existing CIM projects. Based on the analysis of existing CIM projects with this framework, a prescriptive CIM framework was developed. This framework addresses all dimensions identified in the studied CIM projects and can be regarded as covering the complete 'CIM modeling space'. In this framework, a CIM base model is specified. This language makes it possible to model the complete CIM modeling space in a uniform way with one complete and semantically rich enough language. The specification of (a part of) the CIM modeling space in the form of a CIM reference architecture expressed in the CIM base model is addressed. In this architecture, manufacturing activities, flow objects, CIM components, CIM standards and their interrelationships are modeled which are relevant in the manufacturing of discrete parts. The result of the research is only a first step on the way to CIM. With the CIM framework, the CIM base model, and the CIM reference architecture, some ordering is achieved on paper in the chaos of CIM concepts. ESA

N92-19647# Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin (Germany, F.R.).
NEW GRAPHICS STANDARD-OBJECT ORIENTED
P. Wisskirchen and K. Kansy 1991 21 p
(PB92-114677; GMD-570) Copyright Avail: NTIS HC/MF A03 CSCL 09B

Work towards the 2nd generation graphics standard, New API, has just started. The occasion is taken to compare the needs of graphics standards and benefits of object oriented systems. It is argued that the open demands for graphics standards can reasonably be met only by adopting an object oriented approach. Advantages of such an approach are summarized. Author

N92-19680# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Fields Div.
PERSONAL COMPUTER CODES FOR ANALYSIS OF PLANAR NEAR FIELDS
L. A. Muth and R. L. Lewis Jun. 1991 64 p Sponsored in part by Aerospace Guidance and Metrology Center, Newark, AFS, OH
(PB92-112283; NISTIR-3970) Avail: NTIS HC/MF A04 CSCL 09B

FORTRAN codes were developed for analysis of planar near-field data. Some of the inner workings of the codes, the data management schemes, and the structure of the input/output sections are described to enable scientists and programmers to use these codes effectively as a research tool in antenna metrology. The open structure of the codes allows a user to incorporate into the package new applications for future use with relative ease. The subroutines currently in existence are briefly described, and a table showing the interdependence among these subroutines is constructed. Some basic research problems, such as transformation of a near field to the far field and correction of probe position errors, are carried out from start to finish to illustrate use and effectiveness of these codes. Sample outputs are shown. The advantage of a high degree of modularization is demonstrated by the use of disk operating system (DOS) batch files to execute FORTRAN modules in a desired sequence. GRA

N92-19730# Applied Research Lab., Virginia Beach, VA.
TPS TECHNOLOGY INNOVATIONS STUDY: SUPPLEMENT Final Report
David Gordon 26 Nov. 1991 22 p
(Contract N00189-90-C-0437)
(AD-A244207; Rept-0437-A006-Suppl) Avail: NTIS HC/MF A03 CSCL 12/5

The purpose of this report is to evaluate Computer Aided Engineering (CAE software tools and their application to the Designated Government Acceptance Representative (DGAR) acceptance process. The report discusses the final evaluation results for the CAE study. The focus of the report covers the general methodology for the application of CAE software to the DGAR contract deliverable acceptance process. The CAE application approach is to perform circuit and fault simulations to generate the required technical data in order for the DGAR to technically judge the contractors test program quality. The report concludes that the level of effort to generate technical facts with which to verify the contractor's TPS product was not cost competitive with traditional verification methods. The level of effort to build a circuit simulation model for TPS maintenance, TPS development, and life cycle support cost purposes is extremely cost effective. GRA

N92-19770# Royal Signals and Radar Establishment, Malvern (England).
FROM ENGLISH INTO Z, A REVERSE SPECIFICATION PROCESS
S. C. Giess Jun. 1991 32 p
(AD-A242132; RSRE-91004; BR304189; ETN-92-90689)
Copyright Avail: NTIS HC/MF A03

An exercise in the translation of the communication protocol specification RFC 826, 'the address resolution protocol', already written in English into the mathematical specification language Z, is presented. The overwhelming conclusion is that the attempt to specify this process in a formal manner clearly revealed weaknesses that were opaque in the English. Also, the task of defining the implementation needs for a node would have been much easier if the overall specification had been created in a formal manner in the first place. By using Z, the specification of the individual processes was quickly achieved. However, as suspected from its state based nature, Z was not able to capture the complete configuration, both sequential and parallel, of the individual processes as easily. Indeed, it was decided, again purely for clarity since parallelism can be expressed in Z, not to attempt the complete configuration. For individual titles, see N92-19771 through N92-19771.

N92-19771# Royal Signals and Radar Establishment, Malvern (England). Network Working Group.
AN ETHERNET ADDRESS RESOLUTION PROTOCOL OR CONVERTING NETWORK PROTOCOL ADDRESSES TO 48.BIT ETHERNET ADDRESS FOR TRANSMISSION IN ETHERNET HARDWARE
David C. Plummer *In its* From English into Z, A Reverse Specification Process Jun. 1991 p 11-19 (For primary document see N92-19770 10-61)
Copyright Avail: NTIS HC/MF A03

The implementation of protocol P on a sending host S decides, through protocol P's routing mechanism, that it wants to transmit to a target host T located some place on a connected piece of

10 Mbit Ethernet cable. To actually transmit the Ethernet packet, a 48 bit Ethernet address must be generated. The addresses of hosts within protocol P are not always compatible with the corresponding Ethernet address (being different lengths or values). A protocol, that allows dynamic distribution of the information needed to build tables to translate an address A in protocol P's address space into a 48 bit Ethernet address, is presented. Generalizations were made which allow the protocol to be used for non-10 Mbit Ethernet hardware. Some packet radio networks are examples of such hardware. ESA

N92-19805# Sandia National Labs., Albuquerque, NM.
SANET 1.0 USER'S GUIDE AND REFERENCE MANUAL
A. L. Camp and L. P. Abeyta Dec. 1991 45 p
(Contract DE-AC04-76DP-00789)
(DE92-005563; SAND-91-2864) Avail: NTIS HC/MF A03

SANET is a computer program intended for use in constructing, evaluating, and printing event trees for safety and reliability studies. SANET allows the user to graphically construct event trees, assign probabilities to the branches on the tree, and include a variety of labels. Fast, publication quality printed output can be obtained. SANET requires an IBM compatible PC with a 80286, 80386 or 80486 processor, VGA graphics, a mouse, and an HP Laserjet printer. DOE

N92-19811# Applied Research Lab., Virginia Beach, VA.
TPS TECHNOLOGY INNOVATIONS Interim Report
David Gordon 26 Aug. 1991 71 p
(Contract N00189-90-C-0437)
(AD-A244427; Rept-0437-A006) Avail: NTIS HC/MF A04
CSCL 12/5

This report discusses important CAE software features required in the application of CAE software for Test Program Set (TPS) development. It also identifies an application method of CAE software to generate TPS information, and lays the groundwork for identifying a CAE software application method for the Designated Government Acceptance Representative's evaluation of the TPS design. The report discusses the application of Computer Aided Engineering (CAE) tools for the TPS development process, CAE software selection criteria, and evaluation recommendations for CAE tools. All TPS development tasks, from schematic entry to ATLAS code generation, are discussed and partially documented using the SRA under study. Optimum CAE environment capabilities and features are identified for maximum TPS engineering productivity and efficiency. Study results to data indicate that a total CAE approach for TPS development demonstrates great potential in TPS development productivity, efficiency, and quality. The analog simulator, Saber, is recommended as the analog simulation software because of the simulator's fault simulation and simulator modelling language capabilities. These capabilities allow the TPS engineer to generate an analog fault dictionary, which is an essential element to TPS development. Further recommendations are to select a CAE environment and the accompanying CAE software for TPS development. GRA

N92-19828*# Arizona Univ., Tucson. Dept. of Computer Science.
ACCESSING FILES IN AN INTERNET: THE JADE FILE SYSTEM
Larry L. Peterson and Herman C. Rao 24 Jan. 1991 34 p
(Contract NCC2-561; NSF CCR-88-11423; NSF NCR-90-05028)
(NASA-CR-189930; TR-90-30; NAS 1.26:189930) Avail: NTIS HC/MF A03 CSCL 09B

Jade is a new distribution file system that provides a uniform way to name and access files in an internet environment. It makes two important contributions. First, Jade is a logical system that integrates a heterogeneous collection of existing file systems, where heterogeneous means that the underlying file systems support different file access protocols. Jade is designed under the restriction that the underlying file system may not be modified. Second, rather than providing a global name space, Jade permits each user to define a private name space. These private name spaces support two novel features: they allow multiple file systems to be mounted under one directory, and they allow one logical name space to mount other logical name spaces. A prototype of the Jade File System was implemented on Sun Workstations running Unix. It consists of interfaces to the Unix file system, the Sun Network File System, the Andrew File System, and FTP. This paper motivates Jade's design, highlights several aspects of its implementation, and illustrates applications that can take advantage of its features. Author

N92-19835# Naval Postgraduate School, Monterey, CA.
ANDVT RATE CONVERSION ALGORITHM (FROM 2400 B/S TO 1200 B/S) Final Report
George S. Kang and Larry J. Fransen 27 Dec. 1991 28 p
(NR Proj. X72-90)
(AD-A244340; NRL-9357) Avail: NTIS HC/MF A03 CSCL 25/4

The 2400 b/s linear predictive coder (LPC) is currently being widely deployed to support tactical voice communication over narrowband channels. However, lower-data-rate voice encoders are needed for special applications: improved performance in high-bit-error conditions and implementation of integrated voice/data systems. In this report, we generated a rate-conversion algorithm to compress voice data rate from 2400 b/s to 1200 b/s. Rate reduction is effected outside the Advanced Narrowband Digital Voice Terminal (ANDVT), requiring no modification to the ANDVT software and hardware. This is a cost-effective way of obtaining 1200 b/s voice data for special communication requirements. Speech intelligibility at 1200 b/s, as measured by the Diagnostic Rhyme Test, is 90.4, which is only 1.7 points below that of the 2400 b/s LPC. Thus, the 1200 b/s speech is as acceptable as 2400 b/s speech. Author (GRA)

N92-19839# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
VECTOR PROCESSING TIME CHART ANALYSIS PROGRAM (VTAP) SIMULATION OF VECTOR PROCESSING COMPUTERS
Hajime Miyoshi, Haruo Hatama, and Yukihiro Karube Feb. 1991 29 p In JAPANESE; ENGLISH summary
(NAL-TR-1094; ISSN-0389-4010) Avail: NTIS HC/MF A03

The Vector processing Time chart Analysis Program (VTAP) is a software simulator used to simulate the vector processing of the Fujitsu VP series and other computers. This simulator enables the development of enhanced compiler technology and user programming skills, while also advancing data acquisition for the development of new vector computers. Both the VP series hardware and operations are discussed, with the corresponding VTAP functions and simulation contents being explained. VTAP simulation accuracy was investigated by comparing the VTAP estimated program processing time with the measured time in the VP400 and VP200 models. The obtained VTAP simulation accuracy was 94.5 percent for the VP400 and 98.8 percent for the VP200 simulations. Author

N92-19842*# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
MEASUREMENT-BASED RELIABILITY PREDICTION METHODOLOGY M.S. Thesis
Linda Shen Linn May 1991 43 p
(Contract NAG1-613; N00014-90-J-1270)
(NASA-CR-189913; NAS 1.26:189913; UILU-ENG-91-2236; CRHC-91-25) Avail: NTIS HC/MF A03 CSCL 09B

In the past, analytical and measurement based models were developed to characterize computer system behavior. An open issue is how these models can be used, if at all, for system design improvement. The issue is addressed here. A combined statistical/analytical approach to use measurements from one environment to model the system failure behavior in a new environment is proposed. A comparison of the predicted results with the actual data from the new environment shows a close correspondence. Author

N92-19845*# Arizona Univ., Tucson. Dept. of Computer Science.
UNIVERS: THE CONSTRUCTION OF AN INTERNET-WIDE DESCRIPTIVE NAMING SYSTEM
C. Mic Bowman 10 Aug. 1990 84 p
(Contract NCC2-561)
(NASA-CR-189931; NAS 1.26:189931; TR-90-27) Avail: NTIS HC/MF A05 CSCL 09B

Descriptive naming systems allow clients to identify a set of objects by description. Described here is the construction of a descriptive naming system, called Univers, based on a model in which clients provide both an object description and some meta-information. The meta-information describes beliefs about the query and the naming system. Specifically, it is an ordering on a set of perfect world approximations, and it describes the preferred methods for accommodating imperfect information. The description is then resolved in a way that respects the preferred approximations. Author

N92-19862# General Accounting Office, Washington, DC. Human Resources Div.
QUESTIONNAIRE PROGRAMMING LANGUAGE (QPL) DATA COLLECTION PROGRAM, VERSION 3.0
Sep. 1991 53 p Supersedes PB90-181603; PB91-228437 (PB92-102508; GAO/SW/DK-92/001B) Avail: NTIS HC/MF A04 CSCL 09B

The Questionnaire Programming Language (QPL) is a system of programs that are designed to automate much of the process of gathering and analyzing questionnaire data. The manual describes how to use one of the programs, COLLECT, to enter data, usually during a telephone interview, and add it to a data file. The COLLECT program can be run on either a floppy or hard disk IBM personal computer. Author

N92-19865# National Inst. of Standards and Technology, Gaithersburg, MD.
GLOSSARY OF COMPUTER SECURITY TERMINOLOGY
E. Roback Sep. 1991 177 p
(PB92-112259; NISTIR-4659) Avail: NTIS HC/MF A09 CSCL 09B

The glossary provides a summary of frequently encountered computer and communications security terms and various definitions used by federal agencies for those terms. The glossary does not provide a single definition per term, rather it reflects the variations in use of these terms among federal organizations. GRA

N92-19886# Sandia National Labs., Albuquerque, NM.
PHYSLIB: A C++ TENSOR CLASS LIBRARY
K. G. Budge Oct. 1991 86 p
(Contract DE-AC04-76DP-00789)
(DE92-004113; SAND-91-1752) Avail: NTIS HC/MF A05

C++ is the first object-oriented programming language which produces a sufficiently efficient code for consideration in computation-intensive physics and engineering applications. In addition, the increasing availability of massively parallel architectures requires novel programming techniques which may prove to be relatively easy to implement in C++. For these reasons, Division 1541 at Sandia National Laboratories is devoting considerable resources to the development of C++ libraries. This document describes the first of these libraries to be released, PHYSLIB, which defines classes representing Cartesian vectors and (second-order) tensors. This library consists of the header file physlib.h, the inline code file physlib.inl, and the source file physlib.C. The library is applicable to both three-dimensional and two-dimensional problems; the user selects the 2-D version of the library by defining the symbol TWO D in the header file physlib.h and recompiling physlib.C and his own code. Alternately, system managers may wish to provide duplicate header and object modules of each dimensionality. This code was produced under the auspices of Sandia National Laboratories, a federally-funded research center administered for the United States Department of Energy on a non-profit basis by AT&T. This code is available to U.S. citizens, and institutions under research, government use and/or commercial license agreements. DOE

N92-19927# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
GLOBAL VIRTUAL TIME APPROXIMATION WITH DISTRIBUTED TERMINATION DETECTION ALGORITHMS
Friedemann Mattern, Horst Mehl (Kaiserslautern Univ., Germany, F.R.), A. Anneke Schoone, and Gerard Tel Sep. 1991 32 p
(Contract EEC-3075; DFG-SPP-322671)
(RUU-CS-91-32; ISSN-0924-3275; ETN-92-91099) Avail: NTIS HC/MF A03

It is shown that distributed termination detection algorithms can be transformed into efficient algorithms to approximate the so-called Global Virtual Time (GVT) of a distributed monotonic computation. Typical instances of such computations are optimistic distributed simulations based on the time-warp principle. The transformation is exemplified for two termination detection algorithms, namely an algorithm by Dijkstra et al. and a new scheme based on the principle of 'sticky flags'. The general idea of the transformation is that many termination detection algorithms (one for each possible GVT value) run parallel. Each algorithm determines a specific lower bound in the current GVT value. In a straightforward way, the possibly infinite bundle of parallel termination detection algorithms can be combined into a single distributed algorithm which computes a tight lower bound on the GVT. ESA

N92-19929# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
SUPERPOSITION REFINEMENT OF PARALLEL ALGORITHMS
R. J. R. Back (Abo Akademi, Turku, Finland) and K. Sere Sep. 1991 22 p Sponsored by Technology Development Center and Netherlands Organization for Applied Scientific Research
(RUU-CS-91-34; ISSN-0924-3275; ETN-92-91100) Avail: NTIS HC/MF A03

Superposition refinement enhances an algorithm by superposing one computation mechanism onto another mechanism, in a way that preserves the behavior of the original mechanism. Superposition seems to be particularly well-suited to the development of parallel and distributed programs. An originally simple sequential algorithm can be extended with mechanisms that distribute control and state information to many processes, thus permitting efficient parallel execution of the algorithm. A study showing how superposition of parallel algorithms is expressed in the refinement calculus is presented. The power of this method is illustrated by a case study, showing how a distributed broadcasting algorithm is derived through a sequence of superposition refinements. ESA

N92-19933# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
COMPLEXITY ASPECTS OF 2-DIMENSIONAL DATA COMPRESSION
H. Bodlaender, T. Gonzalez, and T. Kloks Sep. 1991 38 p Sponsored in part by Foundation for Computer Science
(Contract EEC-3075)
(RUU-CS-91-35; ISSN-0924-3275; ETN-92-91101) Avail: NTIS HC/MF A03

Let M be a two-dimensional colored map which has been digitized into a large two-dimensional array (M). A class of languages (called rectilinear) to describe the digitized maps and classify them based on their level of succinct representation are defined. The map compression problem, i.e. the problem of finding for any given map a shortest description within a given language, is studied. For one-dimensional maps, it is shown that a shortest description can be generated quickly for some languages, but for other languages the problem is NP hard. A large number of linear time algorithms for the language are shown to generate map descriptions whose length is at most twice the length of the minimum length description. For all the languages, the two-dimensional map compression problem is shown to be NP

hard. For one of the most succinct of the languages, evidence is presented suggesting that finding a near-optimal map compression is as difficult as finding an optimal compression. ESA

N92-19965# Texas A&M Univ., College Station. Texas Transportation Inst.

MODULUS 4.0, USER'S MANUAL Final Report, Sep. 1988 - Sep. 1990

T. Scullion and C. Michalak Jan. 1991 48 p Sponsored in part by Federal Highway Administration, Austin, TX; and Texas State Dept. of Highways and Public Transportation, Austin

(PB92-113034; TTI-2-18-87-1123-4; RR-1123-4; FHWA/TX-91/1123-4) Avail: NTIS HC/MF A03 CSCL 09B

The MODULUS Program, a modulus backcalculation system, was developed for the Texas Department of Highways and Public Transportation. The system is intended to be used when analyzing data collected with only the falling weight deflectometer. The following enhancements were made in the version of the software: (1) automatic calculation of a depth to a stiff layer (H4), which can be overwritten by the user; (2) automatic calculation of weighting factors for each sensor; (3) detection of nonlinearity in the subgrade, and automatic selection of the optimum numbers of sensors to use in the backcalculation process; (4) the use of the Corps of Engineers WES5 linear elastic program which is considerably faster than existing programs and has no copyright restrictions; and (5) inclusion of a routine to permit manual input of deflection bowl data. One minor restriction on the version of MODULUS is that four of the deflection sensors must be located at offsets of 0, 12, 24, and 36 inches from the center of the load plate. GRA

N92-19969# National Inst. of Standards and Technology, Gaithersburg, MD.

PROCEEDINGS OF THE FORUM ON STANDARDS FOR HIGH INTEGRITY SOFTWARE (DOD, GOVERNMENT, INDUSTRY)

D. R. Wallace, M. Brown, and A. McKinlay Sep. 1991 64 p Prepared in cooperation with Naval Surface Warfare Center, Dahlgren, VA; and McDonnell-Douglas Corp., St. Louis, MO

(PB92-112267; NISTIR-4656) Avail: NTIS HC/MF A04 CSCL 09B

Information related to the Forum of Standards for High Integrity Software (Department of Defense, Goverment, and Industry) held at the National Institute of Standards and Technology (NIST) on 28 Jun. 1991 is provided. At the forum, software engineering experts presented their perspectives on the role of software engineers in software safety, a comparison for safety and computer security issues in standards, hazard analysis, assurance standards, and software certification. Future directions for NIST activities for assurance of high integrity software were proposed. GRA

N92-19970# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Security Div.

COMPUTER SECURITY BULLETIN BOARD SYSTEM: USER'S GUIDE

M. Skandera and M. Swanson Sep. 1991 40 p

(PB92-112390; NISTIR-4667) Avail: NTIS HC/MF A03 CSCL 09B

The Computer Security Act of 1987 assigned to the National Institute of Standards and Technology (NIST) the responsibility of providing federal agencies with advice and assistance in the area of computer security. To accomplish a portion of the task, the NIST Computer Security Division maintains an electronic bulletin board system (BBS) which focuses on computer security information available to federal agencies and to the public, and encourages the sharing of information which can help users and managers protect their data and systems. The BBS is described, and detailed instructions on how to use the many functions is provided. GRA

N92-20004# National Research Council of Canada, Ottawa (Ontario). Div. of Electrical Engineering.

COMMERCIAL REALTIME SOFTWARE NEEDS DIFFERENT CONFIGURATION MANAGEMENT

W. Morven Gentleman, S. A. MacKay, D. A. Stewart, and M. Wein Nov. 1989 15 p Presented at the Second International Workshop on Software Configuration Management, Princeton, NJ, Oct. 1989

(NRC-30939; ERB-1025; CTN-92-60392) Avail: NTIS HC/MF A03

This paper presented an argument as to why integrated, monolithic configuration management systems are not well suited to commercial realtime systems. The paper introduced the concept of layering parallel trees as a model for evolving software. Layering of trees was shown to solve the vexing problem of how new versions can be introduced without invalidating earlier ones. The configuration management scheme presented here deliberately does not impose a specific database management system, but rather it uses the conventional tree-structured file system as its basis. While a conventional tree-structured file system is not ideal for maintaining code databases, it is the most flexible and most generally available in all plausible development systems. The selector file concept is shown to offer many advantages. It permits explicit definition of specific configurations by enumeration of components. This approach has proven to be more flexible than schemes based on specification of attributes. Also, the selector file, which defines a particular configuration, is the unit that is submitted to the compiler, therefore guaranteeing consistency between intent and what is actually compiled. The Database and Selectors Cel (DaSC) approach has proved more satisfactory than conventional configuration management schemes. CISTI

N92-20008# Audesyn, Inc., Edmonton (Alberta). Advanced Technology Centre.

ANALYSIS OF THE CORRECTNESS OF AUTOMATICALLY SYNTHESIZED CONTROLLERS

W. Lloyd Elwood and John P. Knight Mar. 1989 80 p Sponsored by Department of National Defence

(AUTR-88-02; CTN-92-60398) Copyright Avail: NTIS HC/MF A05

In circuit design the circuitry is traditionally divided into data and control paths. The control path generates a sequence of signals which cause the data path to perform the necessary operations. This report focuses on some of the issues which must be considered in the design, by verifiable hardware synthesis systems such as Elf, of trusted controllers for electronic circuit systems. The techniques used in the extraction of the controller specification from the high level specification are described. The high level specification of the circuit involves concepts like loops, forks, and subroutines which must be decomposed to describe their true meaning. The use of productions is one way of carrying out this operation. Also discussed are protocol verification techniques, and the problems arising in microcode compaction, state reduction, and state assignment. A control specification, called a symbolic controller, is essentially a state machine which can be synthesized by a variety of techniques. The controller can be decomposed into a command generator which generates the control words to the data path, and a sequencer which determines the next word to be generated. The various types of command generators and control sequencers which are appropriate for automatically designed controllers are described in detail. Techniques, which can be used to identify errors in the controller under construction, are described including the use of error correcting codes and watchdog processors. These techniques can be used on either the sequencer or command generator. CISTI

N92-19313*# Memphis State Univ., TN. Dept. of Mechanical Engineering.

INVESTIGATION OF THE FINITE ELEMENT SOFTWARE PACKAGES AT KSC

Chu-Ho Lu *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 210-235 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 09B

N92-19649# Meteorological Satellite Center, Tokyo (Japan).
A LOCATION ALGORITHM OF ARGOS DATA COLLECTION PLATFORM
Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 1-9 In JAPANESE; ENGLISH summary (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

N92-19651# Meteorological Satellite Center, Tokyo (Japan).
ON ENHANCEMENT DISPLAYING OF GMS IMAGE
Tomoyuki Harada *In its* Meteorological Satellite Center Technical Note No. 20, 1990 Mar. 1990 p 23-32 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N92-19648 10-47)
Avail: NTIS HC/MF A05

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-19078# Syracuse Univ., NY. Dept. of Electrical and Computer Engineering.
PERMUTATION SETS AND ROUTABILITY OF MULTISTAGE INTERCONNECTION NETWORKS (MIN'S) Final Report, Jul. - Sep. 1989
C. Y. Chen and Calvin J. Hsia Nov. 1991 193 p
(Contract F30602-88-D-0027)
(AD-A244069; RL-TR-91-284) Avail: NTIS HC/MF A09 CSCL 12/7

A multistage interconnection network is one of the most important components for designing high-performance parallel supercomputers and for providing a powerful reconfigurable programming environment such that programming is independent of the actual computer architectures. In this research, some fundamental issues in multistage interconnection networks are investigated. Results, which promise great potential for the design of a reconfigurable high-speed parallel supercomputer with an architecture independent programming environment, are presented. First, two characteristic functions are introduced to characterize networks in a proposed class of multistage interconnection networks. Message routing schemes, network partitioning algorithms, and many other useful properties are presented. Next, a more general class of multistage interconnection networks and two more general characteristic functions are introduced. The transformation rules for one network to emulate another in the class is presented such that the programs and algorithms developed on one machine can be reused on others. Then, the permutation capability (in terms of non-conflict parallel communication) of each network is presented through the concept of network partitioning. An algorithm to determine the admissibility of any permutation on a multistage interconnection network is developed. Finally, a fault-tolerant reconfiguration scheme is presented for parallel processor systems which employ multistage interconnection GRA

N92-19644# In-MaRC, Inc., Bismarck, ND.
UNIQUE APPLICATIONS FOR ARTIFICIAL NEURAL NETWORKS, PHASE 1 Final Report
8 Aug. 1991 39 p
(Contract DAAH01-91-C-R116)
(AD-A243365) Avail: NTIS HC/MF A03 CSCL 15/6

The investigation concerns the application of modular neural networks, working synergistically with genetic search, to provide a powerful means of intelligently controlling heuristic mathematical algorithms for large-scale vehicle routing and scheduling problems. The design lends itself naturally to parallel computing on loosely coupled networks of computers, and to implementation on parallel architectures such as MIMD machines. Extensive developmental work, coding and computational testing was carried on generic vehicle routing problems. The results are consistently superior to known alternatives, and provide strong motivation to extend the approach into more complex problem domains and military applications. The basic approach was also applied to routing problems with time constraints, a significant complication of considerable practical importance. Results of this problem are also consistently good, and there is potential to further investigate the use of the approach in this domain. Finally, very preliminary results are available for applying the methodology to routing and mission planning for remote autonomous military vehicles, such as Tomahawk cruise missiles or other smart weapons systems. In summary, the high performance achieved suggests that the multiparadigm approaches that utilize methods from artificial intelligence in conjunction with powerful and proven methods from mathematical combinatorial optimization can build upon the strengths of each constituent, and achieve performance that none of the methods can obtain in isolation. GRA

N92-19715# Ames Lab., IA.
THE WORK/EXCHANGE MODEL: A GENERALIZED APPROACH TO DYNAMIC LOAD BALANCING Ph.D. Thesis
M. C. Wikstrom 20 Dec. 1991 173 p
(Contract W-7405-eng-82)
(DE92-005156; IS-T-1589) Avail: NTIS HC/MF A08

A crucial concern in software development is reducing program execution time. Parallel processing is often used to meet this goal. However, parallel processing efforts can lead to many pitfalls and problems. One such problem is to distribute the workload among processors in such a way that minimum execution time is obtained. The common approach is to use a load balancer to distribute equal or nearly equal quantities of workload on each processor. Unfortunately, this approach relies on a naive definition of load imbalance and often fails to achieve the desired goal. A more sophisticated definition should account for the affects of additional factors including communication delay costs, network contention, and architectural issues. Consideration of additional factors led us to the realization that optical load distribution does not always result from equal load distribution. In this dissertation, we tackle the difficult problem of defining load imbalance. This is accomplished through the development of a parallel program model called the Generalized Work/Exchange Model. Associated with the model are equations for a restricted set of deterministically balanced programs that characterize idle time, elapsed time, and potential speedup. With the aid of the model, several common myths about load imbalance are exposed. A useful application called a load balancer enhancer is also presented which is applicable to the more general, quasi-static load unbalanced program. DOE

N92-19985# Ames Lab., IA.
SCALABILITY OF PARALLEL ALGORITHM-MACHINE COMBINATIONS
Xian-He Sun and D. T. Rover Apr. 1991 38 p
(Contract W-7405-eng-82)
(DE92-007053; IS-5057) Avail: NTIS HC/MF A03

Scalability has become an important consideration in parallel algorithm and machine designs. The word scalable, or scalability, has been widely and oftenly used in the parallel processing community. However, there is no adequate, commonly accepted definition of scalability available. Scalabilities of computer systems and programs are difficult to quantify, evaluate, and compare. In this paper, scalability is formally defined for algorithm-machine combinations. A practical method is proposed to provide a quantitative measurement of the scalability. The relation between the newly proposed scalability and other existing parallel performance metrics is studied. A harmony between speedup and scalability has been observed. Theoretical results show that a large class of algorithm-machine combinations is scalable and the scalability can be predicted through premeasured machine parameters. Two algorithms have been studied on an nCUBE 2 multicomputer and on a MasPar MP-1 computer. These case studies have shown how scalabilities can be measured, computed, and predicted. Performance instrumentation and visualization tools also have been used and developed to understand the scalability related behavior. DOE

N92-20006# National Research Council of Canada, Ottawa (Ontario). Div. of Electrical Engineering.
REALTIME APPLICATIONS: MULTIPROCESSORS IN HARMONY
W. Morven Gentleman Aug. 1989 14 p Presented at the Bus/Board Users' Show and Conference, New York, NY, 3-6 Oct. 1988
(NRC-30692; ERB-1011; CTN-92-60394) Avail: NTIS HC/MF A03

Multiprocessor architectures offer integrators of realtime systems numerous advantages not found in single processor systems. Multiprocessor systems are inherently configurable, allowing both functional specification at processor level and the ability to add computing capacity as required. Multiprocessor systems generally use proven conservative hardware technologies that can provide reliability and resiliency to outages. Such systems, however, present a special set of problems to designers of realtime operating systems. The model of processor connectivity and the demands of realtime processing force treatment of issues not addressed in other systems. Harmony, an inherently multiprocessor multitasking realtime operating system, is examined in this light.
Author (CISTI)

N92-20009# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
PRELUDE: A SYSTEM FOR PORTABLE PARALLEL SOFTWARE
William Weihl, Eric Brewer, Adrian Colbrook, Chrysanthos Dellarocas, and Wilson Hsieh Oct. 1991 28 p
(Contract N00014-89-J-1988)
(AD-A243114; MIT/LCS/TR-519) Avail: NTIS HC/MF A03
CSCL 12/5

In this paper we describe PRELUDE, a programming language and accompanying system support for writing portable MIMD parallel programs. PRELUDE supports methodology for designing and organizing parallel programs that makes them easier to tune for particular architectures and to port to new architectures. It builds on earlier work on Emerald, Amber, and various FORTRAN extensions to allow the programmer to divide programs into architecture-dependent and architecture-independent parts, and then to change the architecture-dependent parts to port the program to a new machine or to tune its performance on a single machine. The architecture-dependent parts of a program are specified by annotations that describe the mapping of a program onto a machine. PRELUDE provides a variety of mapping mechanisms similar to those in other systems, including remote procedure call, object migration, and data replication and partitioning. In addition, PRELUDE includes novel migration mechanisms for computations based on a form of continuation passing. The implementation of object migration in PRELUDE uses a novel approach based on fixup blocks that is more efficient than previous approaches, and amortizes the cost of each migration so that the cost per migration drops as the frequency of migrations increases.
GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-19113 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
AUTOMATIC CLAIMS DERIVATION FROM A USER'S SECURITY POLICY USING AI TECHNIQUES
Richard Lampard Sep. 1991 30 p Sponsored by Dept. of Trade and Industry
(NPL-DITC-187/91; ISSN-0262-5369; ETN-92-91044) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

The possibility of automatically deriving a set of functionality requirements from a user's security policy using artificial intelligence (AI) techniques is investigated. These requirements would be expressed in terms of the Information Technology Security Evaluation Criteria Claims (ITSEC) Language. This would allow the user to express his requirements rigorously, and would facilitate their comparison with a set of claims made about specific security product or system, also written in the language. Some comments on the feasibility of such a venture are given in conclusion.
ESA

N92-19213# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NECESSARY CONDITIONS DERIVATION FOR THE SOLUTION OF OPTIMAL CONTROL PROBLEMS WITH FRACTIONED-DYNAMICS AND NON-DIFFERENTIAL CONSTRAINTS Ph.D. Thesis
Ricardo Luiz Utsch d Pinto Feb. 1991 102 p In PORTUGUESE; ENGLISH summary
(INPE-5305-TDI/455) Avail: NTIS HC/MF A06

A set of necessary conditions for the solution of a very general class of optimal control problems is derived. This process is performed in a gradual manner, starting with an ordinary problem of optimal control with mixed-boundary constraints, going through the analysis of multi-boundary constraints and non-differential constraints, and culminating with the solution of a problem here described as an 'optimal fractioned-dynamics control problem'. The derivation is based in an implicit function theorem, and combines ideas of some of the previous works with those of the author. Didactic aspects of the deduction methodology are considered, enabling the work to be used as a necessary conditions deduction routine, instead of just posing a set of necessary conditions properly speaking. This can be useful in the derivation of other classes of optimal problems or in practical problems where a numerical solution is required. Examples focusing on many aspects are solved. It is hoped that this work is useful for the solution of space technology problems, as well as for applications in other areas.
Author

N92-19344# Case Western Reserve Univ., Cleveland, OH.
NEURAL NETWORKS FOR REAL-TIME SENSORY DATA PROCESSING AND SENSORIMOTOR CONTROL
Randall D. Beer 13 Dec. 1991 5 p
(Contract N00014-90-C-1545)
(AD-A244424) Avail: NTIS HC/MF A01 CSCL 06/5

In our experimental work over the past six months we have made progress in both the behavioral and physiological areas. Behaviorally, we have continued our efforts to define the effects of leg deficits. In physiological experiments, we have documented the relative timing of wind evoked activity in individual ventral giant interneurons (vGIs). We have performed behavioral observations both on whole leg ablation and on animals that have received lesions of specific proprioceptors of the mesothoracic legs. High speed video data clearly demonstrated that both of these procedures altered the escape movements. However, the changes that were observed were not consistent from animal to animal. In the leg ablation procedures, we found that removal of mesothoracic legs initially caused the animal to simply escape forward. This is consistent with our observations on intact animals that indicated that much of the turning direction comes from the actions of the mesothoracic legs. Nevertheless, when we retested the animals three to five days after the ablation, some of the turning ability returned. We then moved the system to the tethered preparation where we could obtain more direct information on leg movements. It was our hope that this could explain the changes seen in the free ranging animal.
GRA

N92-19385# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN EXPERT SYSTEM ADVISOR FOR MEDICAL EVALUATION BOARDS M.S. Thesis
Jerry S. Harrington Dec. 1991 102 p
(AD-A243922; AFIT/GIR/DEV/91D-8) Avail: NTIS HC/MF A06
CSCL 12/9

Expert system technology has proven itself to be able to improve productivity and decision making in a variety of fields of

endeavor. The purpose of this study was to determine if an expert system for medical evaluation boards (MEB's) could improve upon the processing of medical evaluation board cases. Research was conducted to develop an expert system and measure the capabilities of the system, both in terms of accuracy and timeliness of case completion of the medical evaluation administrators/clerks who were assisted by the system. The research methodology involved a three phase approach. The objective of phase one was to choose a problem to be addressed by the expert system and find a domain expert who would provide the knowledge that would be encoded into the system to solve the problem. Phase two, the knowledge engineering phase, involved the extraction of knowledge from the domain expert as well as supporting documentation, to create the knowledge base for the expert system. Phase-three performance evaluation involved the evaluation of the developed system to determine the effect it had on the accuracy and timeliness of MEB case completion by medical administrators/clerks. GRA

N92-19397# California Univ., Berkeley. Electronics Research Lab.
ADAPTIVE CONTROL OF NONLINEAR SYSTEMS WITH APPLICATIONS TO THE CONTROL OF FLEXIBLE ROBOT ARMS Final Report, 15 Jun. 1988 - 14 Jun. 1991
S. S. Sastry 28 Oct. 1991 36 p
(Contract DAAL03-88-K-0106)
(AD-A244409; ARO-25844.13-MA) Avail: NTIS HC/MF A03
CSCL 12/4

On this grant we made major progress in three areas. The first was adaptive control of nonlinear systems. In this work, we extended our previous work on direct adaptive control of Single Input single output nonlinear systems to schemes for adaptive identification, indirect adaptive control and also adaptive model matching of multi input multi output nonlinear systems. We also studied adaptive versions of the nonlinear regulator. The second area was approximate linearization (by state feedback) of nonlinear systems. While the full set of conditions for input-output linearization of a nonlinear system by state feedback have been given in the literature, the question of how to proceed when the conditions follow slightly short of being met have not been answered. For example, input-output linearization hinges on a certain set of regularity conditions (existence of relative degree in the SISO case) and minimum phase conditions being met by the plant. If the plant is not regular and is slightly nonminimum phase the techniques of input-output linearization need to be modified. We discussed these techniques in the context of flight control and also other examples, for instance, the ball and beam system. This in turn led to a deeper understanding of the structure of the zero dynamics of a nonlinear system and their structure under perturbation. The third area was CAD tools for nonlinear controller design. We have developed a set of CAD tools for linearization and approximate linearization of nonlinear systems using spline software which operates in real time and is capable of accepting nonlinear system description in numeric, tabular, or functional form. A user interface is being written and is is being tried out on several examples. GRA

N92-19408# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
HARDWARE AND SOFTWARE ARCHITECTURE FOR EXECUTION CONTROL OF AN AUTONOMOUS MOBILE ROBOT Ph.D. Thesis - Toulouse Univ.
Rogerio FerrazdeCamargo 1991 199 p In FRENCH; ENGLISH summary
(LAAS-91272; ETN-92-90671) Avail: NTIS HC/MF A09

A general hardware and software architecture concept for the execution control of autonomous mobile robots is presented. The concepts are applied in building HILARE 2, a new experimental mobile robot. The control structure of a complex robotic system is viewed as being made up of successive software layers, built on top of the physical robot. The virtual robot layer implements access to the physical robot by higher level software layers. The next layer, called the module substratum, consists of a group of functional modules which cooperate to accomplish the tasks required by a central controller which verifies the state of the robot and the environment, ensures planned actions applicability, and starts the execution of these actions to detect or recover from possible failures. ESA

N92-19513# Integrated Systems, Inc., Santa Clara, CA.
ADAPTIVE AND NONLINEAR CONTROL FOR RAPID MANEUVERING OF FLEXIBLE STRUCTURES Final Report, Sep. 1987 - Jun. 1991
Robert L. Kosut and Guntekin M. Kabuli 1 Oct. 1991 90 p
(Contract F49620-88-C-0012)
(AD-A243991; ISI-5733-05; AFOSR-91-0971TR) Avail: NTIS HC/MF A05 CSCL 22/1

This report describes research results on the design of feedback controllers for rapid slewing of flexible space structures, such as optical tracking systems. Two approaches evolved during this research. The first approach modifies the exact rigid-body time-optimal control so as to account for chattering near zero tracking error and robustness to flexible modes close to the controller bandwidth. Efforts to make this controller adaptive are also presented. The second approach uses a combination of feed forward trajectory generation with a standard linear feedback in the inner loop. The feed-forward generator is designed by solving a convex optimization problem which is an approximation to the time-optimal problem. The latter approach is effective for multiple input multiple output systems with independent actuator saturation constraints. GRA

N92-19569 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
SIMULATION OF NEURAL NET LEARNING USING BOOLEAN DOUBLE ARGUMENTS [IMITATSIIAOBUCHENIIA NEIROSETI DVUKHARGUMENTNYM BULEVYM FUNKTSIIAM]
Na. Protsenko and L. V. Taranenkol 1990 41 p In RUSSIAN
Copyright Avail: Issuing Activity

A Pascal program is proposed which simulates the neural net learning of a double input single output neural net, by full and partial double argument Boolean function. Out of 16 fully functional nets, 14 learn in a stable manner. Equivalence and non-equivalence (excluding or), the learning for which takes place only through initially favorable power distribution of connections between neurons, were exceptions. The net learns all partial double argument functions. Transl. by L.K.H.

N92-19315*# Baylor Univ., Waco, TX. Dept. of Engineering and Computer Science.
KATE'S MODEL VERIFICATION TOOLS
Steve Morgan *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 261-317 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-19051# California Univ., Los Angeles. Dept. of Mathematics.
NUMERICAL METHODS FOR SOLVING LARGE SPARSE EIGENVALUE PROBLEMS AND FOR THE ANALYSIS OF BIFURCATION PHENOMENA Final Report, 15 May 1988 - 14 May 1991
Tony F. Chan Oct. 1991 6 p
(Contract DAAL03-88-K-0085)
(AD-A244273; ARO-24857.12-MA) Avail: NTIS HC/MF A02
CSCL 12/1

Research was concerned with designing and analyzing efficient and novel iterative algorithms for solving large sparse linear systems, typically arising from the discretizations of partial

differential equations, which are highly parallelizable and converge fast. These include domain decomposition algorithms and multilevel preconditioners. Some basic dense linear algebra problems, including rank-revealing QR factorizations and stable Toeplitz solvers, which have applications to signal processing were considered. GRA

N92-19068# Georgia Univ., Athens. Dept. of Physics and Astronomy.
INTERDISCIPLINARY STUDY IN PHYSICAL MATHEMATICS Final Report, 28 Sep. 1987 - 1 Sep. 1991
M. H. Lee 15 Nov. 1991 5 p
(Contract DAAL03-87-K-0110)
(AD-A244280; ARO-24166.38-MA) Avail: NTIS HC/MF A01
CSCL 12/1

A study of nonlinear differential and integral equations which describe time-dependent phenomena in fluids and solids has been conducted by a team of investigators at the University of Georgia. The methods of study employed include computer simulations, recurrence relations, linearization. Among significant findings are a demonstration of slow decay in a Hermitian many-body system for the first time. The origin and mechanisms of slow decay have been elucidated. The study has resulted in nearly 30 articles, most of which are in refereed journals of international standing. GRA

N92-19091# Purdue Univ., West Lafayette, IN. Dept. of Computer Sciences.
PARALLEL METHODS AND SYSTEMS FOR SOLVING PARTIAL DIFFERENTIAL EQUATIONS Final Report, 1 Aug. 1988 - 30 Apr. 1991
Elias N. Houstis 30 Apr. 1991 11 p
(Grant AF-AFOSR-0243-88; AF Proj. 2304)
(AD-A243822; AFOSR-91-0941TR) Avail: NTIS HC/MF A03
CSCL 12/1

The results of this grant are: (1) development and analysis of new methods and methodologies for solving PDEs on parallel machines, (2) development of mapping strategies of PDE computations to parallel machines, (3) development of knowledge bases for parallel PDE solvers, (4) development of a facility for visualization, collection and analysis of performance data, (5) development of a machine independent object-oriented knowledge interface for specifying PDE computations and solvers, and (6) performance evaluation of PDE solvers on Intel and NCUBE hypercube machines. The feasibility of the proposed ideas was established and usable prototypes have been developed. GRA

N92-19116# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TWO- AND THREE DIMENSIONAL POINT LOCATION IN RECTANGULAR SUBDIVISIONS
Mark deBerg, Marc vanKreveld, and Jack Snoeyink (British Columbia Univ., Vancouver.) Aug. 1991 18 p Sponsored by Commission of the European Communities and Netherlands Organization for Applied Scientific Research TNO
(RUU-CS-91-29; ISSN-0924-3275; ETN-92-91096) Avail: NTIS HC/MF A03

Van Emde Boas type stratified trees are applied to point location problems in rectangular subdivisions in 2 and 3 dimensions. In a subdivision with n rectangles having integer coordinates from the closed interval (1,U), an integer query point is located in O((loglogU) exp d) query time using O(n) space when d is less than or equal to 2 or O(nloglogU) space when d = 3. Applications and extensions of this 'fixed universe' approach include point location using logarithmic time and linear space in rectilinear subdivisions having arbitrary coordinates, point location in c oriented polygons or fat triangles in the plane, point location in subdivisions of space into 'fat prisms', and vertical ray shooting among horizontal 'fat objects'. Like other results on stratified trees, the algorithms run on a random access machine model and make use of perfect hashing. ESA

N92-19130# International Centre for Theoretical Physics, Trieste (Italy).
TRANSFORMATIONS OF SOME INDUCED osp(3/2) MODULES IN AN so(3)+sp(2) BASIS
Anh Ky Nguyen, T. D. Palev, and N. I. Stoilova Jul. 1991 40 p
(DE92-603595; IC-91/192) Avail: NTIS HC/MF A03

The modules of the orthosymplectic Lie superalgebra osp(3/2), induced from finite-dimensional irreducible submodules of the stability subalgebra so(3)+gl(1) are investigated. The corresponding to them infinite-dimensional irreducible or indecomposable modules, the Kac modules and the related typical and atypical modules are studied in detail. Every such module is decomposed into a direct sum of either indecomposable or irreducible modules of the even subalgebra so(3)+sp(2). For each of these (infinite-dimensional or finite-dimensional, irreducible or indecomposable) modules relations are written down, giving the transformations of the basis under the action of the algebra generators. DOE

N92-19173# Colorado Univ., Boulder.
NEW METHODS FOR NONLINEAR OPTIMIZATION Final Report, 15 May 1988 - 14 May 1991
Robert B. Schnabel and Richard H. Byrd 29 Aug. 1991 10 p
(Contract DAAL03-88-K-0086)
(AD-A244404; ARO-24923.11-MA) Avail: NTIS HC/MF A02
CSCL 12/2

This research project has investigated topics in unconstrained and constrained optimization, solving systems of nonlinear equations, nonlinear least squares, and parallel optimization. Over the course of this research contract, considerable progress was made in all the areas discussed in the proposal, namely tensor methods for nonlinear equations and optimization, trust regions methods for nonlinearly constrained optimization, orthogonal distance regression, semilocal analysis of quasi-Newton methods for nonlinearly constrained optimization, and parallel unconstrained optimization. In addition, we have worked on several other topics, including a new modified Cholesky factorization, analysis and performance of the symmetric rank one update for unconstrained optimization, secant methods for constrained optimization, the behavior of Broyden class methods for unconstrained optimization, and parallel and sequential methods for global optimization. GRA

N92-19207 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
THEORY OF GALVANOMAGNETIC PHENOMENA IN CRYSTALS OF LOW SYMMETRY [TEORIIA GALVANOMAGNITNYKH IAVLENII V KRISTALLAKH NIZKOI SIMMETRII]
N. P. Gorlei, T. A. Zagorodniaia, A. I. Skitsko, P. M. Tomchuk, and V. A. Shenderovskii 1989 53 p In RUSSIAN
Copyright Avail: Issuing Activity

Using an approximation method for the solution of Boltzman kinetic equations, disregarding interval changes, the author develops a theory of galvanomagnetic phenomenon in crystals of low symmetry. Analytic expressions are derived for the component of a tensor of electrical activity, which possesses a uniform character and can be used during analysis of occurrences of transfer in semiconductors, metal, and semimetals. The developed theory is applied to research of the kinetic coefficient in tellurium semiconductors with a trigonal lattice and a reliably established zone structure. Transl. by L.K.H.

N92-19301# Rutgers - The State Univ., New Brunswick, NJ. Center for the Mathematical Sciences.
ANALYSIS AND REGULATION OF NONLINEAR SYSTEMS Final Report, 1 Aug. 1988 - 31 Jul. 1991
Eduardo D. Sontag 31 Jul. 1991 17 p
(Grant AF-AFOSR-0235-88)
(AD-A244171; AFOSR-91-0933TR) Avail: NTIS HC/MF A03
CSCL 12/1

The research reported deals with the control of nonlinear systems. Among the topics covered are: State-space and I/O

stabilization, systems with saturated controls, universal formulas for Lyapunov-function based feedback, neural-net controllers, discrete time controllability and sample control, input/output algebraic-differential equations, and certain types of Hamiltonian systems. GRA

N92-19346 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
A THEORY OF ASYMPTOTIC EXPANSION OF INTEGRALS USING THE METHOD OF STEEPEST DESCENT [TEORIIA ASIMPTOTICHESKIKH RAZLOZHENII INTEGRALOV PO METODU PEREVALA]
V. P. Lukomskii and I. V. Sedletskii 1990 49 p In RUSSIAN
Copyright Avail: Issuing Activity

In the framework of a unified approach based on the method of steepest descent, a theory is developed for the asymptotic expansion function of multiple exchange of fixed contour intervals in a complex plane. A perturbation theory is constructed for the case of close arrangement of axis points. The uniform asymptotic expansion is also derived. Specially introduced q-numbers are used to derive the simple recurring formulas for calculation of coefficients of corresponding expansions in all of these instances.
Transl. by L.K.H.

N92-19388# Maryland Univ., College Park. Dept. of Mathematics.
NONLINEAR MECHANICS AND APPLIED ANALYSIS Final Report, 1 Jun. 1989 - 31 Oct. 1991
John H. Maddocks 31 Oct. 1991 4 p
(Grant AF-AFOSR-0376-89; AF Proj. 2304)
(AD-A243978; AFOSR-91-0998TR) Avail: NTIS HC/MF A01
CSCL 12/2

Many important Hamiltonian systems have periodic solutions that are associated with symmetries of the equations. While it is well known that stationary solutions of a Hamiltonian system can be characterized as extremals of the potential energy, it is less widely appreciated that symmetry-related periodic solutions, or relative equilibria, can also be given a variational characterization, typically involving constraints. This variational characterization is important because if a periodic solution is associated with a constrained minimizer (in some sense), as opposed to merely being a stationary point, then a stability result is very often available. We are therefore left with the problem of characterizing those extremals of a constrained variational principle that are actually constrained local minima. It is shown how to apply the new results in the special context of Hamiltonian mechanics, and various stability and instability theorems are described. The machinery developed here can be viewed as an alternative to the energy-casimir and energy-momentum methods with the benefit that the necessary tests can be concretely and rigorously applied in several complex examples of physical importance. GRA

N92-19395# Duke Univ., Durham, NC. Dept. of Computer Science.
METEORS: HIGH PERFORMANCE THEOREM PROVERS USING MODEL ELIMINATION
O. L. Astrachan and D. W. Loveland Mar. 1991 31 p
(Contract DAAL03-88-K-0082)
(AD-A244405; CS-1991-8; ARO-25195.9-MA-AI) Avail: NTIS HC/MF A03 CSCL 12/2

Historically, depth-first (linear) resolution procedures have not fared well in proving deeper theorems relative to breadth-first resolution provers of various types, primarily because of the search redundancy problem. However, we can now demonstrate that the model eliminator (ME) procedure, a linear-input resolution-like procedure, may be a superior approach for certain types of problems (generally non-Horn problems). There is a conjunction of reasons why the METEOR provers presently appear so effective. The reasons are: the inherent speed advantage of linear input systems; the sophistication of the WAM architecture in exploiting this advantage; a program written in the language C using tight coding and effective data structures; the speed of the platforms on which they run; and the successful use of different search strategies. We explore single processor and parallel processor implementations of ME using different versions of interactive depth-first search. Among the theorems we prove are variants of a problem in calculus for which this ME theorem prover is presently the only uniform first-order proof procedure realization that has succeeded in proving these variants. GRA

N92-19474# International Centre for Theoretical Physics, Trieste (Italy).
NEW PERTURBATION APPROACH FOR THE LOCALIZATION TRANSITION IN THE DISSIPATIVE TWO-STATE SYSTEM
Guang-Ming Zhang, Hong Chen (Tongji Univ., Shanghai, China), and Xiang Wu Aug. 1991 16 p
(DE92-603744; IC-91/223) Avail: NTIS HC/MF A03

Analysis of a dissipative two-state system shows that the model Hamiltonian may be exactly reduced to a modified quantum sine-Gordon model, which describes the effective interactions between the low-frequency phonons under coupling with a tunneling system. Direct consideration of the infrared divergence, encountered in the conventional perturbation treatment, led to the development of a new perturbation approach for the effective Hamiltonian. Additionally, we derived the exact critical conditions for the localized transition. In the critical regime, a gap will open near zero momentum in the elementary excitation spectrum of the low-frequency phonons, and the corresponding ground-state wave function is found to be a pairing quasi-particle state, analogous to the BCS superconducting state. DOE

N92-19568 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. for Problems in Energy Conservation.
BOUNDARY-VALUE PROBLEMS OF FILTRATION THEORY IN DEFORMABLE MASSES [KRAEVYE ZADACHI TEORII FILTRATSII V DEFORMIRUEMYKH MASSIVAKH]
V. M. Bulavatskii and P. A. Rudchenko 1989 34 p In RUSSIAN
Copyright Avail: Issuing Activity

The solution of problems of groundwater filtration play an important role during the design, building, and operation of a power station. These problems are closely related to problems of energy conservation. In the framework of a theory of filtration consolidation of soil in the proposed linear skeletal creep, the structures are satisfied and a numerical-analytic solution is derived for a series of two-dimensional and three-dimensional boundary problems of consolidation of water saturated subterranean masses of a rectangular cross section, drained with vertical drains. The solution to the problem presented is derived by a differential difference method coupled with the Polozhiv summary representation for the numerical solution of problems of mathematical physics.
Transl. by L.K.H.

N92-19639# International Centre for Theoretical Physics, Trieste (Italy).
COEFFICIENTS OF SINGULARITIES AND MIXED METHODS FOR THE MIXED DIRICHLET-NEUMANN PROBLEM FOR THE STOKES OPERATOR ON A POLYGON
M. Chettab (Annaba Univ., Algeria) and M. S. Lubuma Nov. 1990 21 p
(DE91-632244; IC-90/240-Rev) Avail: NTIS HC/MF A03

The behavior of the weak solution of the Stokes problem on a polygon is considered with emphasis on the maximal regularity of the solution and on global formulae for the coefficients of singularities. This regularity leads to a slow convergent mixed finite element method of fractional order less than one, while the use of the above formulae provides better approximations for the solution and for the coefficients. DOE

N92-19695# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
TRANSVERSAL HAMILTONIAN FIELDS AND DIFFERENTIAL RELATIONS
L. Polterovich Sep. 1991 14 p
(PB92-114099; IHES/M/91/61) Avail: NTIS HC/MF A03
CSCL 12A

Consider a Lagrangian submanifold L of a symplectic manifold M. Let xi be the Hamiltonian field generated by a smooth function H : M yields R. An important observation, which leads to V.I. Arnold's famous conjecture on the Lagrangian intersections, can be formulated as follows: there is a one to one correspondence between critical points of the restriction H on L and points where xi is tangent to L. In particular, if L is closed, then every Hamiltonian field on M is somewhere tangent to L. Here, the authors show that this property breaks for a wide class of middle dimensional closed non-Lagrangian submanifolds of a symplectic manifold. This class includes non-Lagrangian parallelizable submanifolds which are totally real with respect to an almost complex structure compatible with the symplectic one, as well as for non-Lagrangian sub-manifolds which are sufficiently close to a Lagrangian one.
Author

N92-19787# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DISCRETE SIMULATION OF FRACTIONAL ORDER SYSTEMS M.S. Thesis
Jeffrey A. Blank Dec. 1991 88 p
(AD-A243914; AFIT/GA/ENY/91D-15) Avail: NTIS HC/MF A05
CSCL 12/1

Fractional calculus has been shown useful for describing many real world systems, and studies are currently underway to generalize control theory to incorporate fractional states. This investigation derives a method for simulating the time response of fractional order systems using a recursive difference equation. The technique used effectively approximates a simple fractional order integrator as a summation of integer order terms. The discrete transfer function is also derived and the frequency response of the discrete algorithm is compared to the exact continuous case. Using 20 or more retained past values in the difference equation, the discrete half-order integrator demonstrates a passband of more than three decades. A slightly modified method is used to derive a recursive difference equation which simulates the response of a modal fractional order differential equation. Frequency response analysis of an example having an eigenvalue of -1 shows the characteristics of a low pass filter, effectively simulating the continuous system response for all frequencies below the Nyquist limit, even when using a small number of retained past values.
GRA

N92-19793# Utah State Univ., Logan. Dept. of Mathematics and Statistics.
NUMERICAL SOLUTION OF NONLINEAR ALGEBRAIC EQUATIONS IN STIFF ODE SOLVING (1986-89)-QUASI-NEWTON UPDATING FOR LARGE SCALE NONLINEAR SYSTEMS (1989-90)
H. F. Walker 1990 7 p
(Contract DE-FG02-86ER-25018)
(DE92-004839; DOE/ER-25018/4) Avail: NTIS HC/MF A02

During the 1986-1989 project period, two major areas of research developed into which most of the work fell: 'matrix-free' methods for solving linear systems, by which we mean iterative methods that require only the action of the coefficient matrix on vectors and not the coefficient matrix itself; and Newton-like methods for underdetermined nonlinear systems. In the 1990 project period of the renewal grant, a third major area of research developed: inexact Newton and Newton iterative methods and their applications to large-scale nonlinear systems, especially those arising in discretized problems. An inexact Newton method is any method in which each step reduces the norm of the local linear model of the function of interest. A Newton iterative method is any implementation of Newton's method in which the linear systems that characterize Newton steps (the 'Newton equations') are solved only approximately using an iterative linear solver. Newton iterative methods are properly considered special cases of inexact Newton methods. We describe the work in these areas and in other areas in this paper.
DOE

N92-19812# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
EXISTENCE AND UNIQUENESS OF COMPLETE CONSTANT MEAN CURVATURE SURFACES AT INFINITY OF H(SUP 3)
John A. Velling Jun. 1991 52 p
(Contract PSC-CUNY-661365)
(PB92-114065; IHES/M/91/47) Avail: NTIS HC/MF A04
CSCL 12A

Let H exp 3 denote the usual hyperbolic 3-space. Concern is with an apparently new use of quasiconformal analysis in surface theory and a criterion, the satisfaction of which is equivalent to a surface sigma sub 0 yields H exp 3 having constant mean curvature, H(sigma sub 0) = c.
GRA

N92-19831# Michigan State Univ., East Lansing. Dept. of Mathematics.
APPLICATIONS OF ADAPTIVE FINITE ELEMENT METHODS TO PROBLEMS IN ESTIMATION AND CONTROL FOR PARTIAL DIFFERENTIAL EQUATIONS Final Report, 15 Jun. 1989 - 14 Jul. 1991
Patricia A. Lamm 14 Jul. 1991 5 p
(Grant AF-AFOSR-0419-89; AF Proj. 2304)
(AD-A244052; AFOSR-91-0931TR) Avail: NTIS HC/MF A01
CSCL 12/1

The purpose of this grant has been to undertake research in the general area of adaptive-grid finite element methods in estimation and control problems. The overall goal has been to investigate adaptive gridding numerical algorithms and to develop a solid theory to handle the mathematical questions of convergence and stability which arise in the use of such algorithms. The P.I. has met this goal through the study of a number of adaptive-grid finite element methods for parameter estimation problems governed by distributed parameter systems. In addition, stability problems encountered in the implementation of such algorithm have led her to make extensive studies of the ill-posed nature of these problems. In particular, theoretical and numerical studies were undertaken concerning regularization schemes for a number of ill-posed estimation problems. Specific applications considered in this latter study include the inverse heat conduction problem and regularizing aspects of descent methods as used to minimize fit-to-data functions associated with linear estimation problems.
GRA

N92-19851# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
TOWARD TOPOLOGICAL CLASSIFICATION OF CRITICALLY FINITE POLYNOMIALS
S. Hu and Y. Jiang Sep. 1991 13 p
(PB92-114107; IHES/M/91/54) Avail: NTIS HC/MF A03
CSCL 12A

A construction is given of branch cover maps of S sup 2 to itself which are topologically equivalent to critically finite polynomials in the sense of Thurston. The construction is on the invariant laminations. It can be applied to all degrees. This way, the conjecture , given by Milnor, was confirmed about the fixed point portrait of critically finite polynomials.
Author

N92-19884# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
LAGRANGIAN FORMALISM FOR CONSTRAINED SYSTEMS, PART 1
P. N. Pyatov 1990 46 p Submitted for publication
(DE92-608011; IHEP-OTF-90-35-Pt-1; IFVE-OTF-90-35-Pt-1)
Avail: NTIS HC/MF A03

A scheme for the construction of a complete set of Lagrangian constraints applicable to a wide class of Lagrangian mechanical systems is given. In the framework of this scheme Lagrangian constraints are split into projectable and nonprojectable ones (in the sense of Legendre mapping). The role of both of these types of constraints in the given formalism is elucidated. Secondary, tertiary, etc. Hamiltonian constraints are obtained by mapping the projectable Lagrangian constraints onto the surface of primary Hamiltonian constraints in the phase space.
DOE

N92-19909# Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Mathematics.
INTEGRATION OF VECTOR-VALUED CONTINUOUS FUNCTIONS AND THE RIESZ REPRESENTATION THEORY
Liaqat Ali Khan Feb. 1991 12 p Submitted for publication
(PB92-109438; QUAM-91/55) Avail: NTIS HC/MF A03 CSCL 12A

The existence is defined and established of the integral of functions in C sub b(X,E) with respect to certain E' valued measures. A Riesz representation type theorem was also established.
Author

N92-19918# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
CONNECTIONS, METRICS, SYMMETRIES AND SCALAR FIELDS IN COMMUTATIVE AND NON-COMMUTATIVE GEOMETRY
R. Coquereaux Jul. 1991 18 p
(PB92-115625; IHES/P/91/41) Avail: NTIS HC/MF A03 CSCL 12A

The geometrical interpretation of these scalar fields is discussed. Primary interest is in the interpretation of Higgs fields. A particular kind of such fields is addressed that appears naturally when one studies the symmetries of coupled Einstein-Yang-Mills fields. However, the corresponding geometrical interpretation does not cover all possible kind of situations. In particular, it fails to recover the case of the Higgs fields appearing in the standard model of electroweak interactions. Another kind of interpretation that is related to non-commutative geometry was proposed recently. For this reason, the authors introduce in the last section a few notions that, at least, will not only justify the title of the present contribution, but also provide an introduction to the talk of G. Esposito Farese (this conference). Before that, and because the authors need the corresponding results later, they shall discuss the geometrical framework that lies behind Kaluza-Klein like theories, i.e., dimensional reduction of metrics. Another kind of scalar fields appear there. The authors start this talk by recalling a few elementary facts about the reduction of bundles and connections. This is clearly related to the mathematical apparatus of general relativity and of its extensions but also directly related to geometry of Higgs fields.
Author

N92-19951# Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Mathematics.
SPHERICALLY SYMMETRIC SPACETIMES-2 (PROPERTIES)
Asgthar Qadir and M. Ziad (Rawalpindi Government Coll. of Technology, Pakistan) May 1991 22 p
(PB92-109446; QUAM-91/59) Avail: NTIS HC/MF A03 CSCL 12A

In the first paper, a complete classification of spherically symmetric spacetimes according to their isometrics and metrics (or classes of metrics) was obtained by solving the Killing equations. Herein, the geometrical and physical properties are discussed of those spacetimes which are not well known (or previously unknown).
Author

N92-19972# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
SOME NEW ESTIMATES ON OSCILLATORY INTEGRALS
Jean Bourgain Sep. 1991 36 p
(PB92-114073; IHES/M/91/60) Avail: NTIS HC/MF A03 CSCL 12A

A summary of recent work on new estimates on oscillatory integrals is presented. The main object underlying the problems discussed are certain operators expressed by an oscillatory integral, roughly of the form Tf(x) = the integral of e(exp i(phi)(x,y))dy where phi is a smooth function of x,y. The aim is to understand the mapping properties of T, namely the pairs of L(sup p1), L(sup p2)-spaces where T acts as a bounded operator, and to estimate its norm. The question is presently only very partially understood, even in the most simple cases. The problem is specified to the following themes: (1) restriction and extension problems; (2) the Bochner-Riesz summation operators; and (3) the (more general) oscillatory integrals considered in a paper by Hormander.
GRA

N92-20010# Naval Postgraduate School, Monterey, CA.
HYPERCUBE SOLUTIONS FOR CONJUGATE DIRECTIONS M.S. Thesis
Jonathan E. Hartman Dec. 1991 380 p
(AD-A243118) Avail: NTIS HC/MF A17 CSCL 12/6

As computing machines advance, new fields are explored and old ones are expanded. This thesis considers parallel solutions to several well-known problems from numerical linear algebra, including Gauss Factorization and the method of Conjugate Gradients. The Gauss algorithm was implemented on two parallel machines: an Intel iPSC/2, and a network of INMOST-800 transputers. Interprocessor communication, in both cases, was borne by a hypercube interconnection topology. The results reveal general findings from parallel computing and more specific data and information concerning the systems and algorithms that were employed. Communication is timed and the results are analyzed, showing typical features of a message passing system. System performance is illustrated by results from the Gauss codes. The use of two different pivoting strategies shows the potential and the limitations of a parallel machine. The iPSC/2 and transputer systems both show excellent parallel performance when solving large, dense, unstructured systems. Differences, advantages, and disadvantages of these two systems are examined and expectations for current and future machines are discussed.
GRA

N92-20024# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
TENSOR PRODUCT OF QUATERNION HILBERT MODULES
L. P. Horwitz and A. Razon Sep. 1991 6 p Sponsored in part by Tel-Aviv Univ., Israel
(PB92-115534; IHES/P/91/58) Avail: NTIS HC/MF A02 CSCL 12A

A solution to the problem of the construction of a tensor product of quaternion modules is given. Annihilation-creation operators are constructed, with Bose-Einstein or Fermi-Dirac statistics. The commutation relations are distorted.
GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-19054# Florida State Univ., Tallahassee. Dept. of Statistics.
THE ROLE OF A MODULE IN THE FAILURE OF A SYSTEM
Emad El-Neweihi and Jayaram Sethuraman Jul. 1991 11 p
(Contract DAAL03-90-G-0103)
(AD-A244277; FSU-TR-M-851; TR-D-119-USARO; ARO-27868.8-MA) Avail: NTIS HC/MF A03 CSCL 12/3

Arrangement increasing and Schur functions play a central role in establishing stochastic inequalities in several areas of statistics and reliability. The role of a module in the failure of a system measures the importance of the module. We define the role to be the probability that this module is among the modules that failed before the failure of the system. A system is called a second order upsilon-out-of-kappa if it is a upsilon-out-of-kappa system based on kappa modules, without common components, and where each module is a alpha i-out-of-n i system. For such systems, we show that the role of a module is an arrangement increasing or Schur function of parameters that describe the system. These results allow us to compare the role of a module under different values of the parameters of the system.
GRA

N92-19055# Florida State Univ., Tallahassee. Dept. of Statistics.
THE ROLE OF A GROUP OF MODULES IN THE FAILURE OF SYSTEMS
Emad El-Neweihi, Jayaram Sethuraman, and A. M. Abouammoh

Aug. 1991 12 p
(Contract DAAL03-90-G-0103)
(AD-A244278; FSU-TR-M-857; TR-D-122-USARO;
ARO-27868.11-MA) Avail: NTIS HC/MF A03 CSCL 12/3

The importance of a module in a system has been a useful concept in Reliability Theory. Several definitions of this concept are available. One such has been called the role of a module in the failure of a system. It is measured by the probability that the module has failed at the time of the failure of the system. In an earlier paper we studied interesting properties of this measure for a class of second order c-out-of-d systems. In this paper we consider the role of a group of modules. As before this is measured by the probability that at least s modules from this group of modules have failed at the time of the failure of the system, for s = 1,2,.... We use the tools of arrangement increasing functions and majorization to study monotonicity properties of this measure in terms of the parameters of the system. GRA

N92-19105# Stanford Univ., CA. Dept. of Statistics.
GOODNESS OF FIT TESTS FOR SPECTRAL DISTRIBUTIONS
T. W. Anderson Oct. 1991 40 p
(Contract DAAL03-89-K-0033)
(AD-A244414; SU-TR-27; ARO-26394.6-MA) Avail: NTIS HC/MF A03 CSCL 12/3

The spectral distribution function of a stationary stochastic process standardized by dividing by the variance of the process is a linear function of the autocorrelations. The integral of the sample standardized spectral density (periodogram) is a similar linear function of the autocorrelations. As the sample size increases, the difference of these two functions multiplied by the square root of the sample size converges weakly to a Gaussian stochastic process with a continuous time parameter. A monotonic transformation of this parameter yields a Brownian bridge plus an independent radom term. The distributions of functionals of this process are the limiting distributions of goodness of fit criteria that are used for testing hypotheses about the process autocorrelations. An application is tests of independence (flat spectrum). The characteristic function of the Cramer-von Miese statistic is obtained; inequalities for the Kolmogorow-Smirnov criterion are given. Confidence regions for unspecified process distributions are found. GRA

N92-19227# Tilburg Univ. (Netherlands). Dept. of Economics.
SENSITIVITY ANALYSIS OF SIMULATION EXPERIMENTS: TUTORIAL ON REGRESSION ANALYSIS AND STATISTICAL DESIGN
Jack P. C. Kleijnen 1991 37 p
(FEW-474; ETN-92-90889) Avail: NTIS HC/MF A03

A survey of strategic issues in the statistical design and analysis of experiments with deterministic and random simulation models is given. Thse issues concern validation, what-if analysis, optimization, and so on. The analysis uses regression models and least squares algorithms. The design uses classical experimental designs factorials, which are more efficient than one at a time designs are. Moreover, classical designs make it possible to estimate interactions among inputs to the simulation. Simulation models may be optimized through response surface methodology, which combines steepest ascent with regression analysis and experimental design. If there are many inputs, then special techniques such as group screening and sequential bifurcation are useful. Several applications are discussed. ESA

N92-19228# Tilburg Univ. (Netherlands). Dept. of Economics.
IDENTIFYING THE IMPORTANT FACTORS IN SIMULATION MODELS WITH MANY FACTORS
Bert Bettonvil and Jack P. C. Kleijnen 1991 33 p Sponsored by Technische Univ.
(FEW-498; ETN-92-90890) Avail: NTIS HC/MF A03

In practice, simulation models usually have a great many parameters and input variables. A screening technique, which identifies the really important factors, is presented. The technique treats the simulation model as a black box and uses a regression metamodel to approximate the input/output behavior of that black box. The metamodel can account for fitting errors with unknown variance and for the interactions among factors. The technique requires relatively few simulation runs. It applies to both random and deterministic simulations. The technique is demonstrated through a case study of a complicated ecological model. ESA

N92-19242# Naval Ocean Systems Center, San Diego, CA.
MODELING THE DENSITY OF A DISTRIBUTION CONTAINING A JUMP NONSTATIONARITY Final Report
D. J. Marchette Sep. 1991 38 p
(AD-A243852; NOSC/TR-1443) Avail: NTIS HC/MF A03 CSCL 12/3

An algorithm for density estimation in the presence of a jump nonstationary is described. This approach is compared to an approach using a kernel estimator windowed to use a fixed number of data points. Assume a random variable X is distributed with probability density function (pdf) d sub 1 before time t sub J and with pdf d2 after time t sub j. Neither the densities nor t sub j are known. The data are viewed as arriving sequentially, with a requirement to report the pdf estimate after each point. A technique for density estimation under these conditions is proposed which models the density as a mixture of normal distributions. The nonstationarity of the data is accounted for through the use of a weighted window. This approach is compared to a windowed kernel estimator. GRA

N92-19463# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A SPATIALLY PARTITIONED PARALLEL SIMULATION OF COLLIDING OBJECTS M.S. Thesis
Robert S. Moser Dec. 1991 110 p
(AD-A243967; AFIT/GCS/ENG/91D-15) Avail: NTIS HC/MF A06 CSCL 12/5

This study investigated the application of a conservative synchronization paradigm to the classical, distributed pool balls simulation executed on an eight node, Intel iPSC/2 hypercube. Wieland's concept of spatial partitioning and limited data replication was used. Analysis has shown that 100 percent parallelization of execution is possible in a conservative environment via assignment of multiple sectors to nodes. Two conservative formulations for minimum safe time were derived. A tradeoff exists between scalability and efficiency. Optimum sectoring prediction has been shown possible through application of linear regression techniques. The results of this research reveal that a conservative approach to distributed, discrete event simulations can achieve significant speedup. GRA

N92-19464# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN ANALYSIS OF TRACKING AND IMPACT PREDICTIONS M.S. Thesis
Susanne V. Lefebvre Dec. 1991 57 p
(AD-A243968; AFIT/GSO/ENG/91D-11) Avail: NTIS HC/MF A04 CSCL 22/2

The accuracy of the United States Space Command's early Tracking and Impact Predictions and its OPREP-3 report initiation procedure are analyzed. The study involves satellites which decayed between 1987 and 1990. Each of the early decay predictions are compared to the final prediction with the resulting time error compared to the accuracy level asserted by the Space Surveillance Center. The results of this study indicate that the accuracy of the decay predictions is usually, but not always, within the asserted accuracy level. The results also suggest the existence of a positive bias indicating that the early decay predictions are routinely late relative to the final decay prediction. Six multiple linear regression models were then developed in an attempt to improve the prediction process. It was determined that incorporating the developed regression models into the prediction process would substantially improve the decay predictions. It was also determined that the OPREP-3 report initiation decision should continue to be made six hours before decay, but that it should also incorporate the developed regression models and widen its error window. GRA

N92-19536*# Michigan Univ., Ann Arbor.
STUDY ON ADVANCED INFORMATION PROCESSING SYSTEM Final Report
Kang G. Shin and Jyh-Charn Liu Washington NASA. Langley Research Center Feb. 1992 35 p
(Grant NAG1-981)
(NASA-CR-4428; NAS 1.26:4428) Avail: NTIS HC/MF A03 CSCL 12A

Issues related to the reliability of a redundant system with large main memory are addressed. In particular, the Fault-Tolerant Processor (FTP) for Advanced Launch System (ALS) is used as a basis for our presentation. When the system is free of latent faults, the probability of system crash due to nearly-coincident channel faults is shown to be insignificant even when the outputs of computing channels are infrequently voted on. In particular, using channel error maskers (CEMs) is shown to improve reliability more effectively than increasing the number of channels for applications with long mission times. Even without using a voter, most memory errors can be immediately corrected by CEMs implemented with conventional coding techniques. In addition to their ability to enhance system reliability, CEMs--with a low hardware overhead--can be used to reduce not only the need of memory realignment, but also the time required to realign channel memories in case, albeit rare, such a need arises. Using CEMs, we have developed two schemes, called Scheme 1 and Scheme 2, to solve the memory realignment problem. In both schemes, most errors are corrected by CEMs, and the remaining errors are masked by a voter. Author

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-19457# Massachusetts Inst. of Tech., Cambridge. Lab. for Information
ANALYSIS, ESTIMATION, AND CONTROL FOR PERTURBED AND SINGULAR SYSTEMS AND FOR SYSTEMS SUBJECT TO DISCRETE EVENTS Final Technical Report, 1 Oct. 1987 - 30 Sep. 1991
Alan S. Willsky 18 Oct. 1991 25 p
(Grant AF-AFOSR-0032-88; AF Proj. 2304)
(AD-A243959; LIDS-R-2076; AFOSR-91-0949TR) Avail: NTIS HC/MF A03 CSCL 12/3

In this report we summarize our accomplishments in the research program supported by Grant AFOSR-88-0032 over the period from October 1, 1987 to September 30, 1991. The basic scope of this program is the analysis, estimation, and control of complex systems with particular emphasis on (1) multiresolution modeling and signal processing; (2) the investigation of theoretical questions related to singular systems; and (3) the analysis of complex systems subject to or characterized by sequences of discrete events. These three topics are described in the next three sections of this report. A full list of publications supported by Grant AFOSR-88-0032 is also included. GRA

N92-19487# Technische Univ., Delft (Netherlands).
MEDESS: A METHODOLOGY FOR DESIGNING EXPERT SUPPORT SYSTEMS Ph.D. Thesis
Jim Adriaan vanWeelderen 1991 175 p Sponsored by KEMA
(ISBN-90-353-1027-6; ETN-92-90880) Copyright Avail: NTIS HC/MF A08

A framework to describe an Expert Support System (ESS) design methodology, derived from the literature in information systems, and using a selected sample of ten contemorary methodological contributions to ESS design, is set up. For each example, how it fits into the framework is determined, and issues in the framework which receive relatively little attention and suggest possible directions for research are identified. With these results in mind, a specific ESS design methodology which incorporates possible proposed improvements is setup. The methodology, MEDESS, is based on insights gained from information systems literature, ESS literature, and other literature related to, for example, operations research, management science and cognitive psychology. To test MEDESS, it is applied to four cases in which an organization wishes to solve a problem concerning the performance of an expert and in which that organization is interested in providing the expert involved with an ESS. An evaluation of whether the improvements proposed and incorporated in MEDESS actually hold in the cases studied is made. The conclusions are based on the extent to which in each of these cases the problems indicated are solved. ESA

N92-19507# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INVESTIGATION OF THE EFFECTS OF INCREASED ORDER COMPENSATORS IN MIXED H2/H(INFINITY) OPTIMIZATION M.S. Thesis
Scott R. Wells Dec. 1991 183 p
(AD-A243874; AFIT/GAE/ENY/91D-14) Avail: NTIS HC/MF A09 CSCL 01/1

The problem of minimizing the 2-norm of one transfer function subject to an infinity-norm bound on another transfer function is examined for increased order controllers. In particular, the theoretical results of the full order case are extended to the higher order case, and SISO and MIMO numerical examples are given for increasingly higher order compensators. Some of the key proofs for higher order compensators include the case where the global minimum 2-norm is unachievable under output feedback for certain levels of gamma regardless of compensator order, and the situation in which the solution to the mixed H2/H infinity problem lies on the boundary of the infinity-norm constraint for this same range of gamma's, and the suboptimal mixed problem converges to the optimal in the limit for higher order controllers. Also, it is shown that the optimal compensator order for the mixed H2/H infinity problem is greater than the order of the plant under certain conditions, and a conjecture about the optimal order for the mixed problem is made. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-19896# Washington Univ., Seattle. Inst. for Nuclear Theory.
SIMULATING NJL-MECHANISM WITH REALISTIC VECTOR-TYPE CONFINING LAGRANGIAN
A. N. Mitra and B. Mitra (Delhi Univ., India) 1991 11 p
(Contract DE-FG06-90ER-40561)
(DE92-004376; DOE/ER-40561/23) Avail: NTIS HC/MF A03

The concrete possibilities for a realistic simulation of the Nambu-Jona Lasino mechanism of dynamical mass generation are examined from the view-point of a Vector-type confining form of 4-fermion Lagrangian with a natural mass scale which substitutes for the canonical NJL-model of contact interaction, and is designed to keep a conscious link with spectroscopy. Such Lagrangians are known to lead (through the minimality condition on the effective Action) to both the Schwinger-Dyson and Bethe-Salpeter equations for the quark-mass operation sigma(rho) and the hadron-quark vertex function Gamma(sub H)(q,P) respectively. With a choice of interactions which correspond to a Lorentz-covariant generalization of the familiar instantaneous approximation, the related Bethe-Salpeter equation already provides a description of both q(bar-q) and qqq spectra, as well as a Lorentz covariant access to different types of transition amplitudes via quark loops, within a common dynamical framework. With this pre-calibration, the model is subjected to the interlinked SDE and BSE for testing some key aspects of the NJL-self consistency mechanism by evaluating some basic constants. The results are: m(sub NJL) = 300 Mev, M(sub pi)(sup 2)is approx. = m(sub c); M(sub sigma) = 857 Mev; (q(bar-q))0 = (219 Mev)(exp 3). From these values two independent estimates of m(sub c) are found as 21.8 and 17.8 (Mev). DOE

N92-19924# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace Science.
A LINEARISED RIEMANN SOLVER FOR GODUNOV-TYPE METHODS
Sep. 1991 22 p Presented at the AGCFM Workshop, Surrey, England, Sep. 1991
(Cranfield-Aero-9116; ISBN-1-871564-35-2; ETN-92-91054)
Avail: NTIS HC/MF A03; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC 8 sterling pounds

Very simple linearizations for the solution to the Riemann problem for the time-dependent and for the steady-supersonic Euler equations are presented. When used locally in conjunction with Godunov-type methods, computing savings by a factor of about four, relative to the use of exact Riemann solvers, can be achieved. For severe flow regimes, however, the linearization loses accuracy and robustness, and the use of the Riemann solver adaptation procedure is proposed. This retains the accuracy and robustness of the exact Riemann solver and the computational efficiency of the cheap linearized Riemann solver. Reliable and simple switching criteria are presented. Numerical results for one, two, and three-dimensional test problems suggest that the resulting numerical methods are competitive for practical applications in terms of robustness, accuracy, and computational efficiency.
ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-19172# CVC Products, Inc., Rochester, NY.
COMMERCIAL SCALE PRODUCTION OF HIGH TEMPERATURE Annual Report, 15 Sep. 1990 - 15 Sep. 1991
Paul Ballentine 14 Nov. 1991 18 p
(Contract N00014-90-c-0206)
(AD-A244355) Avail: NTIS HC/MF A03 CSCL 20/3

Thin films of YBa2Cu3O(7-x) were deposited onto substrates of up to three inches in diameter by RF planar magnetron sputtering from an 8 inch diameter Y-Ba-Cu-O target. By locating the substrate above the center of the magnetron erosion ring and by placing a 'negative ion shield' between the substrate and the target, negative ion effects are avoided. A large area, backside radiant heater brings the bare substrates up to the temperatures necessary for in situ growth of superconducting YBa2Cu3O(7-x) films. The YBCO sputter deposition is completely automated, and a throughput of 10 two inch diameters per week from a single target is easily achieved. YBCO films have been grown on MgO and LaAlO3 substrates with a critical temperature greater than or equal to 90 K, change of temperature less than 1 K, and critical current density greater than 1 million A/sq cm at 77 K. Microwave resistance for YBCO films on two inch diameter LaAlO3 substrates has been measured and found to be less than 0.62 milliohms with a uniformity of better than +/- 5 percent. On two inch diameter substrates, uniformity of thickness and room temperature resistivity of less than 7 percent have been achieved. The compositional uniformity of Y, Ba, and Cu across a two inch diameter substrate was found to be better than +/- 1 percent. Preliminary work on the growth of Y-ZrO2 dielectric layers and epitaxial YBCO/PLZT bilayers has been initiated.
GRA

N92-19868# Kozponti Fizikai Kutato Intezet, Budapest (Hungary).
CORRELATION BETWEEN MAGNETIC MOMENT AND EXCHANGE INTERACTION DISTRIBUTIONS
I. Vincze, J. Balogh, Z. Foris, D. Kaptas, and T. Kemeny 1990 22 p In ENGLISH; Summaries in HUNGARIAN and RUSSIAN
(PB92-124981; KFKI-1990-64/E) Avail: NTIS HC/MF A03 CSCL 20C

The temperature dependence of the width of the hyperfine field (i.e., magnetic moment) distribution of crystalline Fe3B and Fe-B amorphous alloys with B composition ranging from 12 to 25 at. pct. content is studied. Qualitative differences are observed and explained within the framework of a model which takes into account the correlations between the magnetic moment and exchange interaction distributions.
Author

N92-19907# Gas Research Inst., Chicago, IL.
REVIEW OF PHYSICAL SCIENCES RESEARCH, 1979 - 1990 (GAS RESEARCH INSTITUTE)
Jul. 1991 96 p
(PB91-240697; GRI-91/0217) Avail: NTIS HC/MF A05 CSCL 20C

To meet the expectations and needs of the gas industry and its customers, basic research management techniques were developed that are appropriate for GRI's unique mission oriented research program. These techniques differ from those used in private industry and government. These techniques are described focussing on how GRI selects appropriate research topics, builds consensus for the Physical Sciences research program, and maintains an emphasis on providing useful results. Each of GRI's 37 active research topics are reviewed, describing their goals, results, and future plans. The reviews are presented in three groups: Physics, Chemistry, and Combustion, and each group begins with a summary of recent important results. Useful results of Physical Sciences Research are described throughout, but a comprehensive record of results is not presented.
Author

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-19077# Texas Univ., Austin. Applied Research Lab.
ACOUSTIC BLOCH WAVE PROPAGATION IN A PERIODIC WAVEGUIDE
Charles E. Bradley 24 Jul. 1991 110 p
(Contracts N00014-84-K-0574; N00014-89-J-1109)
(AD-A244068; ARL-TR-91-19) Avail: NTIS HC/MF A06 CSCL 20/1

The propagation of linear, dissipative acoustic Bloch waves in a periodic waveguide is investigated theoretically and experimentally. The waveguide under study is a rigid, fluid-filled, rectangular waveguide that is loaded with a periodic array of rigidly terminated rectangular side branches. Conditions for the existence of Bloch waves in the periodic waveguide are presented. Analytic expressions for the dispersion relation, the impedance function, and the Bloch wave function are derived. Measurements verify the predicted passband/stopband structure of the dispersion relation and show good agreement with the theory.
GRA

N92-19133# Pennsylvania State Univ., University Park. Dept. of Physics.
ACOUSTIC STUDIES OF NEW MATERIALS: QUASICRYSTALS, LOW-LOSS GLASSES, AND HIGH T(SUB c) CONDUCTORS Final Report, 1 Oct. 1988 - 30 Sep. 1991
Julian D. Maynard 18 Dec. 1991 33 p
(Contract N00014-85-K-0701)
(AD-A243843) Avail: NTIS HC/MF A03 CSCL 20/1

The goals of this project involve the development and application of new techniques in acoustics. The goals are: (1) to study the properties of single crystal high temperature superconductor oxide materials with ultrasonic measurements; (2) to study the properties of quasicrystals using ultrasound and acoustic analog systems; and (3) to develop and apply a new resonant photoacoustic technique to measure optical absorption in very low loss glasses and crystals. Major accomplishments include the development of a new method of ultrasound measurement which permits the determination of all of the independent elastic constants of very small samples (a few hundred microns in size), the use of the apparatus to study high temperature superconductor material and aluminum alloy quasicrystals, and the

development and test of a new technique for measuring optical absorption with more than an order of magnitude improvement in sensitivity over existing methods. GRA

N92-19168# Naval Underwater Systems Center, New London, CT.
THE EXISTENCE OF GENERALIZED EIGENFUNCTIONS IN UNDERWATER ACOUSTICS Final Report
11 Dec. 1991 23 p
(AD-A244342; NUSC-TR-8959) Avail: NTIS HC/MF A03
CSCL 20/1

Non-self-adjoint problems occur in underwater acoustics when the square of the wavenumber is given a complex value to allow for volume attenuation. This report shows that complex wavenumbers can give rise to multiple eigenvalues and generalized eigenfunctions in the same way as complex impedance and admittance boundary conditions give rise to multiple eigenvalues. A horizontally stratified acoustic waveguide that supports generalized eigenfunctions in addition to the usual eigenfunctions or normal modes is given as an example. Generalized eigenfunctions occur when the characteristic equation has a zero with a multiplicity greater than one. Both eigenfunctions and generalized eigenfunctions are required to provide a complete representation of some functions. The separation of variables solution for a point source in a waveguide, based on the usual eigenfunctions or normal modes, is not valid for this example. GRA

N92-19199# Florida Univ., Gainesville. Dept. of Psychology.
COMPLEX AUDITORY SIGNALS Final Report, 15 Sep. 1988 - 30 Sep. 1991
David M. Green and Bruce G. Berg 1 Oct. 1991 7 p
(Grant AF-AFOSR-0333-88; AF Proj. 2313)
(AD-A244167; AFOSR-91-0938TR) Avail: NTIS HC/MF A02
CSCL 15/6

The following is a list of the research supported by the Air Force grant during the period September 15, 1988, to September 30, 1991. Basically the research can be divided into five categories: (1) profile analysis research, (2) synchrony detection, (3) dynamic factors, (4) psychophysical methodology, (5) use of Dr. B. Berg's COSS technique to analyze profile experiments. Profile analysis continues to be our central research interest. The question is what are the factors that influence the human listener's ability to detect changes in a complex acoustic spectrum. Synchrony detection refers to the fact that correlation or synchrony between the envelopes of different spectral channels can be used as an important detection cue. Our interest in this area was initially stimulated by Dr. Virginia Richards. GRA

N92-19234# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
BINAURAL SOUND LOCALIZATION USING NEURAL NETWORKS M.S. Thesis
Rushby C. Craig 12 Dec. 1991 121 p
(AD-A243878; AFIT/GE/ENG/91D-13) Avail: NTIS HC/MF A06
CSCL 20/1

The purpose of this study was to investigate the use of Artificial Neural Networks to localize sound sources from simulated, human binaural signals. Only sound sources originating from a circle on the horizontal plane were considered. Experiments were performed to examine the ability of the networks to localize using three-different feature sets. The feature sets used were: time-samples of the signals, Fast Fourier Transform magnitude and cross correlation data, and auto-correlation and cross correlation data. The two different types of sound source signals considered were tones and gaussian noise. The feature set which yielded the best results in terms of classification accuracy (over 91 percent) for both tones and noise was the auto-correlation and cross-correlation data. These results were achieved using 18 classes (20 per class). The other two feature sets did not produce accuracy results as high or as consistent between the two signal types. When using time-samples of the signals as features, it was observed that in order to accurately classify tones of random-frequency, it was necessary to train with random-frequency tones rather than with tones of one, or a few discrete frequencies. GRA

N92-19511# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
MEASURES AGAINST MECHANICAL NOISE FROM LARGE WIND TURBINES: A DESIGN GUIDE
Sten Ljunggren and Melker Johansson (DNV Ingemansson A.B., Sweden) Jun. 1991 30 p
(Contract STEV-506255-5)
(FFA-TN-1991-26; ETN-92-90806) Avail: NTIS HC/MF A03

The noise generated by the machinery of the two Swedish prototypes contains pure tones which are very important with respect to the environmental impact. A discussion of the results of noise measurements carried out at these turbines, that are meant to be used as a guide as to how to predict and control the noise around a large wind turbine during the design stage, is presented. The design targets are discussed, stressing the importance of the audibility of pure tones and not only the annoyance; a simple criterion is cited. The main noise source is the gearbox and a simple empirical expression for the sound power level is shown to give good agreement with the measurement results. The influence of the noise of the gearbox design is discussed in some detail. Formulas for the prediction of the airborne sound transmission to the ground outside the nacelle are presented, together with a number of empirical data on the sound reduction indices for single and double constructions. The structure-borne noise transmission is discussed. ESA

N92-19672*# Lockheed Engineering and Sciences Co., Hampton, VA.
AN INTRODUCTION TO HIGH SPEED AIRCRAFT NOISE PREDICTION Interim Report
Mark R. Wilson Feb. 1992 80 p
(Contract NAS1-19000)
(NASA-CR-189582; NAS 1.26:189582) Avail: NTIS HC/MF A05
CSCL 20A

The Aircraft Noise Prediction Program's High Speed Research prediction system (ANOPP-HSR) is introduced. This mini-manual is an introduction which gives a brief overview of the ANOPP system and the components of the HSR prediction method. ANOPP information resources are given. Twelve of the most common ANOPP-HSR control statements are described. Each control statement's purpose and format are stated and relevant examples are provided. More detailed examples of the use of the control statements are presented in the manual along with ten ANOPP-HSR templates. The purpose of the templates is to provide the user with working ANOPP-HSR programs which can be modified to serve particular prediction requirements. Also included in this manual is a brief discussion of common errors and how to solve these problems. The appendices include the following useful information: a summary of all ANOPP-HSR functional research modules, a data unit directory, a discussion of one of the more complex control statements, and input data unit and table examples. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-19190# Washington State Univ., Pullman. Dept. of Chemistry.
LIGHT-INDUCED ELECTRON TRANSFER COUNTER TO AN ELECTRIC FIELD FORCE IN AN ASYMMETRIC DOUBLE QUANTUM WELL
Mark I. Stockman, Leonid S. Muratov, Lakshmi N. Pandey, and Thomas F. George Jan. 1992 15 p
(Contract N00014-90-J-1193)
(AD-A244138; WSU/DC/92/TR-72) Avail: NTIS HC/MF A03
CSCL 20/5

Electron transfer counter to an electric-field force is predicted for an asymmetrical double quantum well subjected to a dc bias in response to optical (far IR) excitation of an intersubband electronic transition. This transfer exhibits a resonance enhancement when the bias electric field aligns the excited levels in the wide and narrow wells. The transfer effect is driven by the quantum-mechanical delocalization caused by the coherent resonant tunneling which prevails over the electric force. The effect brings about photoinduced increase of the potential difference at the double well and a transient electric current opposite to the direction favored by the bias. GRA

N92-19236# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
INFLUENCE OF THE ELECTRON'S ANOMALOUS MAGNETIC DIPOLE MOMENT ON HIGH-ATOMIC NUMBER ATOMS
Carlos A. S. Almeida and J. AutoNeto (Universidade Federal do Ceara, Fortaleza, Brazil) 1990 17 p
(DE91-641574; CBPF-NF-027/90) Avail: NTIS HC/MF A03

Super heavy atoms (Z greater than 100) are usually studied in the context of the so-called Quantum Electrodynamics of Strong Fields. In this theory the problem of the singularity in the electron energy whenever Z greater than 137 is overcome. This is done by considering the finite size of the nucleus and leads to interesting phenomena, such as the spontaneous production of positrons. Here, we show that, taking into account the contribution from the Anomalous Magnetic Dipole Moment of the electron (by means of an effective theory), within a point nucleus model, is a sufficient condition to obtain regular wave functions and physically acceptable energy values for Z greater than 137. DOE

N92-19257# Washington State Univ., Pullman. Dept. of Chemistry.
KINETICS OF INTERSUBBAND OPTICAL EXCITATION AND PHOTOINDUCED ELECTRON TRANSFER IN AN ASYMMETRIC DOUBLE QUANTUM WELL
Mark I. Stockman, Leonid S. Muratov, Lakshmi N. Pandey, and Thomas F. George Jan. 1992 32 p
(Contract N00014-90-J-1193)
(AD-A244139; WSU/DC/92/TR-73) Avail: NTIS HC/MF A03 CSCL 20/5

Optical excitation of electrons in an asymmetric double quantum well is theoretically examined. The well is biased to align the excited levels and permit resonant electron tunneling. Emphasis is made on the photoinduced transfer of electrons counter to the bias electric field force. Systems with a weak polarization relaxation (dephasing), are studied using the conventional technique of the Schrodinger equation. A density matrix approach is developed to describe optical excitations in the presence of an arbitrary dephasing. Quantum beats, which follow a short-pulse excitation of the double well, are shown to crucially depend on the dephasing. The excitation profiles obtained for cases of different dephasing reveal the full range of tunneling coupling between the wells from completely coherent to incoherent (stepwise). GRA

N92-19339# Los Alamos National Lab., NM.
DIELECTRONIC RECOMBINATION THEORY
K. J. LaGattuta 1991 12 p Presented at the NATO Workshop on Recombination of Atomic Ions, Belfast, Ireland, 6-9 Oct. 1991
(Contract W-7405-eng-36)
(DE92-005020; LA-UR-91-3849; CONF-9110313-1) Avail: NTIS HC/MF A03

A theory now in wide use for the calculation of dielectronic recombination cross sections (sigma(sup DR)) and rate coefficients (alpha(sup DR)) was one introduced originally by Feshbach for nuclear physics applications and then later adapted for atomic scattering problems by Hahn. In the following, we briefly review this theory in a very general form, which allows one to account for the effects of overlapping and interacting resonances, as well as continuum-continuum coupling. An extension of our notation will then also allow for the inclusion of the effects of direct radiative recombination, along with a treatment of the interference between radiative and dielectronic recombination. Other approaches to the calculation of sigma(sup DR) have been described by Fano and by Seaton. We will not consider those theories here. Calculations of alpha(sup DR) have progressed considerably over the last 25 years, since the early work of Burgess. Advances in the reliability of theoretical predictions have also been promoted recently by a variety of direct laboratory measurements of sigma(sup DR). While the measurements of sigma(sup DR) for delta n not = 0 excitations have tended to agree very well with calculations; the case of delta n = 0 has been problematic. However, by invoking a mechanism originally proposed by Jacobs, which takes into account the effect of stray electric fields on high Rydberg states (HRS) participating in the DR process, new calculations have improved the agreement between theory and experiment for these cases. Nevertheless, certain discrepancies still remain. DOE

N92-19356# Rochester Univ., NY.
LOW ENERGY ION-MOLECULE REACTIONS AND CHEMIIONIZATION KINETICS
J. M. Farrar 25 Sep. 1991 7 p
(Contract DE-FG02-88ER-13849)
(DE92-005083; DOE/ER-13849/4) Avail: NTIS HC/MF A02

Our research program is devoted to understanding the dynamics of elementary ionic collisions at the level of the underlying potential surface by measuring energy and angular distributions of reactively scattered products with crossed beam methods over the relative center-of-mass energy range from 0.3 to several eV. We have performed reactive and nonreactive scattering studies on the following proton and hydrogen atom transfer systems: O + NH3 yields OH + NH2 (delta H = -0.2 eV); and O + H2O yields OH + OH (delta H = +0.4 eV). In both of these systems, the reactions are hypothesized to occur on potential energy surfaces having two minima. The first minimum corresponds to the formation of an electrostatically bound complex, e.g., O(H2O), followed by an intramolecular hydrogen atom/proton transfer to yield OH*OH, which may then form the products by cleavage of the complex. DOE

N92-19416# Air Force Academy, CO.
EPRFIT: AN ELECTRON PARAMAGNETIC RESONANCE MODELING AND ANALYSIS PACKAGE VERSION 1.10
Joseph A. Menapace 1 Dec. 1991 39 p
(AF Proj. 2300)
(AD-A244337; FJSRL-TR-91-0003) Avail: NTIS HC/MF A03 CSCL 20/5

EPRFIT is a computerized analysis and modeling package which simulates isotropic EPR spectra. The package performs first and second order spectral simulations of both single configuration species and exchange-broadened species containing up to 7 exchanging configurations. The program simulates spectra composed of up to 2200 individual lines and up to 14 distinct spin species with nuclear spins within the range 0-9.5. The various procedures within the program are accessed via a user friendly menu-based package. Data entry is conducted using a spreadsheet architecture which provides the user with easy access to data for inspection and editing. Simulation data, simulated spectra, and experimental/simulated spectrum comparison files can be retrieved and stored onto hard/floppy disk storage in either ASCII or packed formats. ASCII output provides a useful means for linking the data/spectra to other analysis packages as well as for use in printing/plotting routines. The simulated and comparison spectra can also be displayed and analyzed graphically within the program. Spectral analysis options include spectrum offsetting, panning, zooming, and peak position and intensity identification routines. These operations apply to both simulated and comparison spectra. Hardcopies of the simulation results and any combination of spectra can be printed onto Epson compatible dot matrix printers for future reference or presentation. GRA

N92-19503# State Univ. of New York, Buffalo.
COMPARISON OF GROUP TRANSFER, INNER SPHERE AND OUTER SPHERE ELECTRON TRANSFER MECHANISMS FOR ORGANOMETALLIC COMPLEXES

1991 4 p
(Contract DE-FG02-87ER-13775)
(DE92-004068; DOE/ER-13775/4) Avail: NTIS HC/MF A01

Our studies of reactions of metal carbonyl cations and anions have shown that metal carbonyl cations can catalyze CO exchange reactions on metal carbonyl anions. This result provides further evidence for a mechanism involving attack of the metal carbonyl anion on a carbon of the metal carbonyl cation in CO(exp 2+) transfer reactions. Reaction of metal carbonyl anions with metal carbonyl halides is a common approach to formation of metal-metal bonds. We have begun to use kinetic data and product analysis to understand the formation of homobimetallic versus heterobimetallic products in such reactions. Initial data indicate a nucleophilic attack, possibly through a ring-slippage mechanism. DOE

N92-19555# Washington Univ., Seattle. Dept. of Physics.
ON DEFINING THE UN-DEFINABLE: JETS
S. D. Ellis 1990 7 p Presented at the Workshop on Jet Studies at LEP and HERA, Durham, England, 8 Dec. 1990
(Contract DE-FG06-91ER-40614)
(DE92-004269; DOE/ER-40614/2; CONF-9012124-1) Avail: NTIS HC/MF A02

A brief summary is presented of the current status of jet studies in hadron-hadron collisions. The primary focus is on those issues that would benefit from comparisons of jet samples obtained from hadron-hadron collisions, from e(+) e(-) annihilation events at the large electron-positron collider, LEP, and from deep inelastic collisions at the hadron-electron storage ring, HERA. The important point is that, to perform this comparison properly, the jet various samples must be obtained using the same jet definition. DOE

N92-19561# Brookhaven National Lab., Upton, NY.
SPECULAR AND DIFFUSE X RAY SCATTERING FROM SURFACES AND INTERFACES
M. K. Sanyal 1991 4 p Presented at the Solid State Physics Symposium, Bombay, India, 21-24 Dec. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005010; BNL-46728; CONF-911277-1) Avail: NTIS HC/MF A01

X-ray and neutron scattering studies of surfaces and interfaces have become increasingly popular over the last few years due to the recent developments in both scattering techniques and high intensity sources, particularly synchrotron x-ray sources. Although detailed characterization of any interface requires understanding of scattering both at small angles and in the (wide angle) Bragg reflection regime, we shall restrict ourselves here to discussing only the small angle region. Despite fundamental differences in the basic interactions between x-rays (or neutrons) with atoms, most of the analysis of our x-ray scattering results presented here can be used for neutron studies, with minor modifications. It should be mentioned here that current synchrotron x-ray sources are several orders of magnitude more intense than neutron sources and as a result, for relatively smooth solid surface specular reflectivity, can be measured down to 10(exp -9) with x-rays, whereas for neutrons this value is approximately 10(exp -6) before the measured intensity is buried with diffuse scattering and other background. As we shall discuss, this reduces the resolution with which one can determine density profile at an interface. The plan of this talk is as follows. After giving a brief outline of this method, we shall discuss our results on liquid surfaces first, and then we shall analyze specular and diffuse scattering data of multilayer interfaces. Finally, we demonstrate a new method of anomalous reflectivity to determine electron density profiles of thin films in a model independent way. DOE

N92-19567# Fermi National Accelerator Lab., Batavia, IL.
DIRECT PRODUCTION OF HIGH p(SUB t) LEPTONS AND SEARCH FOR ADDITIONAL HEAVY BOSONS AT 1.8 TeV
M. Gold (California Univ., Berkeley. Lawrence Berkeley Lab.) Oct. 1991 8 p Presented at the 15th Joint International Lepton Photon Symposium at High Energies and European Physical Society (EPS) Conference on High Energy, Geneva, Switzerland, 25 Jul. - 1 Aug. 1991
(Contract DE-AC02-76CH-03000)
(DE92-004117; FNAL/C-91/287-E; CONF-9107172-8) Avail: NTIS HC/MF A02

We have studied the production of high p(sub t) electrons and muons and searched for additional heavy charged (W prime) and neutral (Z prime) vector bosons. We find no evidence for such bosons and set limits of M(sub w prime) greater than 520 GeV and M(sub Z prime) greater than 412 GeV (95 percent confidence level) assuming Standard Model couplings. The production of high mass electron and muon pairs is consistent with the Standard Model prediction for the Drell-Yan production mechanism. Lower limits of 2.2 TeV and 1.6 TeV (95 percent confidence level) are set on electron-quark and muon-quark compositeness scale parameters (Lambda minus sup LL) associated with an effective contact interaction. DOE

N92-19577# Lawrence Livermore National Lab., CA.
Ab CALCULATIONS ON COLLISIONS OF LOW ENERGY ELECTRONS WITH POLYATOMIC MOLECULES
T. N. Rescigno 1 Aug. 1991 12 p Presented at the 17th International Conference on the Physics of Electronic and Atomic Collisions, Brisbane, Australia, 10-16 Jul. 1991
(Contract W-7405-eng-48)
(DE92-001822; UCRL-JC-108101; CONF-910746-4) Avail: NTIS HC/MF A03

The Kohn variational method is one of simplest and oldest techniques for performing scattering calculations. Nevertheless, a number of formal problems, as well as practical difficulties associated with the computation of certain required matrix elements, delayed its application to electron-molecule scattering problems for many years. This paper describes the recent theoretical and computational developments that have made the 'complex' Kohn variational method a practical tool for carrying out calculations of low energy electron-molecule scattering. Recent calculations on a number of target molecules are also summarized. DOE

N92-19603# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SINGLET OXYGEN EXCITATION OF ATOMIC BROMINE M.S. Thesis
Pauleta R. Rivera Dec. 1991 49 p
(AD-A243938; AFIT/GEP/ENP/91D-6) Avail: NTIS HC/MF A03 CSCL 09/3

The Air Force Phillips Laboratory is interested in developing a new class of laser device that operates in the near infrared. The device is intended for electric optic countermeasure missions. One candidate for such a device is a chemically driven atomic bromine laser operating at 2.7 micrometers. It may be possible to produce excited bromine atoms by energy transfer from singlet oxygen in a manner similar to the Chemical Oxygen Iodine Laser (COIL). The COIL is based on an energy transfer scheme where the energy is stored in the metastable O2 and is transferred to atomic iodine in a near resonant and rapid collisional process. A great deal of information is available on the gas phase kinetics of COIL devices. A similar device based on atomic bromine may be possible, but the prospects for development of this type of system depend critically on the rates of energy transfer from singlet oxygen to bromine atoms. These rates are dependent on molecular oxygen and other species within the laser. GRA

N92-19677# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
CLASSICAL DESCRIPTION OF MOSSBAUER EFFECT WITH EXPERIMENTS IN TRANSIENT REGION AND USING RESTRICTED GEOMETRIES Ph.D. Thesis
Jukka Hietaniemi 1991 47 p Sponsored by Academy of Finland and Wihuri Foundation
(ETN-92-91019) Avail: NTIS HC/MF A03

The basic techniques and methods of Mossbauer spectroscopy are addressed. Theoretical work is based on the use of a classical field picture to describe recoilless gamma radiation. The majority

of experimental work presented is concerned with high frequency excitation of the Mossbauer resonance, which means that the gamma radiation emitted by the source is affected in such a way that its frequency undergoes substantial changes in a time interval comparable to the lifetime of the excited nuclear state. The excitation is accomplished either mechanically or via an external magnetic field. Use of the concept of phase modulation of the classical field to describe the rapid changes in the recoiless radiation provides a working explanation of the phenomena observed. The Mossbauer effect of nuclei confined in restricted geometries is studied. The most significant phenomenon observed in these experiments is the possibility of observing the Mossbauer effect in the liquid regime. It is shown that this phenomenon may be treated on an equal footing with the high frequency phenomena by using the classical approach. ESA

N92-19696# Oak Ridge National Lab., TN.
SUPPRESSION AND SHIFTING OF ODD-PHOTON RESONANT EXCITATIONS AND STIMULATED HYPER-RAMAN EMISSIONS
W. R. Garrett and M. G. Payne 1991 11 p Presented at the SPIE Proceedings, Lasers, Sensors, and Spectroscopy, 1992 OE/LASE, Los Angeles, CA, 19-25 Jan. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005116; CONF-920124-4) Avail: NTIS HC/MF A03

When a principal atomic transition (dipole allowed from the ground state) is driven by odd multiphoton excitation or by stimulated hyper-Raman scattering, a nonlinear multi-wave mixing field is generated at the transition frequency. A number of dramatic effects on such odd photon mediated processes can ensue as a result of the internally generated wave mixing fields. Excellent agreement between theory and experimental studies in Xe and in metal vapors is illustrated for a number of predicted effects including: suppression and strong shifting of resonance lines and hyper-Raman emissions under single and multilaser excitation. We illustrate the dependence of the interference related effects on pressure, oscillator strength, wavelength combination and relative propagation directions of pump laser beams. Contrary to most other nonlinear effects, we show that none of the features (in the semi-classical regime) depends on the intensity of the driving laser field. DOE

N92-19719# Argonne National Lab., IL.
SMALL ANGLE NEUTRON SCATTERING FROM NANOMETER GRAIN SIZED MATERIALS
J. E. Epperson and R. W. Siegel Nov. 1991 9 p Presented at the International Workshop on Studies of Magnetic Properties of Fine Particles and Their Relevance to Materials Science, Rome, Italy, 4-8 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-005241; ANL/CP-74482; CONF-9111164-2) Avail: NTIS HC/MF A02

Small angle neutron scattering has been utilized, along with a number of complementary characterization methods suitable to the nanometer size scale, to investigate the structures of cluster-assembled nanophase materials. Results of these investigations are described and problems and opportunities in using small angle scattering for elucidating nanostructures are discussed. DOE

N92-19723# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RELATIVISTIC BOUND STATES IN QCD
Yu. L. Kalinovskij, W. Kallies, L. Kaschluhn, L. Muenchow, V. N. Pervushin, and N. A. Sarikov (Academy of Sciences of the Uzbek SSR, Tashkent.) 1990 19 p Submitted for publication
(DE92-609099; JINR-E-2-90-354) Avail: NTIS HC/MF A03

This paper is devoted to the construction of the nonlocal theory of hadrons as bound states of quarks and gluons. The starting point of our investigation is relativistic covariant definition of instantaneous bound states and the supposition of the dominance of an instantaneous gluon interaction. The description of the nonlocal relativistic pion to the case of many-quark and many-gluon configurations using an operator approach is generalized. DOE

N92-19732# Purdue Univ., West Lafayette, IN. Dept. of Physics.
ELECTRONIC AND STRUCTURAL PROPERTIES OF INDIVIDUAL NANOMETER-SIZE SUPPORTED METALLIC CLUSTERS
R. Reifenberger Nov. 1991 9 p
(Contract DE-FG02-84ER-45162)
(DE92-005571; DOE/ER-45162/6) Avail: NTIS HC/MF A02

The research supported by this Department of Energy contract has primarily been devoted to the study of the electronic properties of surfaces with sub-micron size. In previous years, we have studied the photoexcitation of electrons from field emission tips by a focussed Argon-ion laser beam tuned to operate at specific photon energy. The photoexcited electrons escape into the vacuum by tunneling through a surface potential barrier which is distorted by the application of a strong electric field. The interest in these experiments lies in a better understanding of the photoexcitation process at low photon energies. The techniques that have been developed directly measure the excited state energy distribution of electrons emitted through the surface potential barrier. The basic information gained from this research is relevant to opto-electronic devices which rely on photoexcitation of electrons in the presence of strong interfacial electric fields for their operation. In addition, the work is very relevant to recent developments in vacuum microelectronic devices that are based on electron emission from arrays of sharp tips. DOE

N92-19734# California Univ., Riverside.
CENTRAL COLLISIONS OF HEAVY IONS
Sun-Yiu Fung Oct. 1991 10 p
(Contract DE-FG03-86ER-40271)
(DE92-006532; DOE/ER-40271/T2) Avail: NTIS HC/MF A02

This report describes the activities of the Heavy Ion Physics Group at the University of California, Riverside from October 1, 1990 to September 30, 1991. During this period, our program focuses on particle production at AGS energies, and correlation studies at the Bevalac in nucleus central collisions. We participated in the preparation of letters of intent for two RHIC experiments (the OASIS proposal, and the Di-Muon proposal) and worked on two RHIC R&D efforts (a silicon strip detector project and a muon identifier project). A small fraction of time was also devoted to physics programs outside the realm of heavy ion reactions by several individuals. DOE

N92-19781# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
SIMULATION OF RESONANCE STRUCTURE OF NEUTRON CROSS SECTIONS IN INELASTIC SCATTERING CHANNELS BY MONTE CARLO METHOD
V. F. Ukraintsev and I. A. Sirakov 1990 7 p In RUSSIAN; ENGLISH summary
(DE92-600648; JINR-R-10-90-130) Avail: NTIS HC/MF A02

Theoretical bases giving account of inelastic scattering and their realization in simulation of the neutron cross section resonance structure in the region of the unresolved levels using Monte Carlo method are described. The single-level Breit-Wigner approximation is used. Comparison between calculated values of average functionals of U-238 cross sections and experimental results is made. The approach allows a computer analysis of the experiments related to even-even nuclei cross sections structure for energies up to 0.5 MeV; fitting the average resonance parameters using such an analysis; and calculation of constants for perspective nuclear reactors. DOE

N92-19794# Stanford Linear Accelerator Center, CA.
LARGE ACCEPTANCE MAGNETIC SPECTROMETERS FOR POLARIZED DEEP INELASTIC ELECTRON SCATTERING
G. G. Petratos, R. L. Eisele, R. A. Gearhart, E. W. Hughes, and C. C. Young Oct. 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC03-76SF-00515)
(DE92-004948; SLAC-PUB-5678; CONF-911106-51) Avail: NTIS HC/MF A02

The design of two magnetic spectrometers for the measurement of the spin-dependent structure function g(sub 1)(sup n) of the neutron and a test of the Bjorken sum rule is described. The measurement will consist of scattering 23 GeV polarized electrons off a polarized He-3 target and detecting scattered electrons of 7 to 18 GeV at 4.5 and 7 degrees. Each spectrometer is based on two large aperture dipole magnets bending in opposite directions. This 'reverse' deflection design doubles the solid angle as compared to the conventional design of same direction bends used in previous experiments. Proper choice of the deflection angles and the distance between the two dipoles in each spectrometer allows background photons from radiative processes to reach the detectors only after at least two bounces off the spectrometer vacuum walls, resulting in an expected tolerable background. Each spectrometer is equipped with a pair of Cerenkov detectors, a pair of scintillation hodoscopes, and a lead-glass shower calorimeter providing electron and pion identification with angular and momentum resolutions sufficient for the experimental measurement. DOE

N92-19803# Continuous Electron Beam Accelerator Facility, Newport New, VA.
FEW-BODY EXPERIMENTAL PROGRAM AT CEBAF
J. Mougey 1991 16 p Presented at the 13th European Conference on Few-Body Problems in Physics, Elba, Italy, 9-14 Sep. 1991
(Contract DE-AC05-84ER-40150)
(DE92-005090; DOE/ER-40150/178; CEBAF-PR-91-046; CONF-9109122-6) Avail: NTIS HC/MF A03

Nearly two thirds of the initial CEBAF physics proposals deal with experimental studies of the nucleon and few nucleon (A less than or equal to 4) systems. These studies include the structure of nucleons at high Q(exp 2), the electro- and photodisintegration of the deuteron, and the short distance structure of He-3 and He-4. Emphasis is given to coincidence experiments and measurements of polarization observables. DOE

N92-19804# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Physics.
PARTIAL-WAVE ANALYSES OF HADRON SCATTERING BELOW 2 GeV
R. A. Arndt and L. D. Roper 1991 5 p
(Contract DE-FG05-88ER-40454)
(DE92-005468; DOE/ER-40454/T1) Avail: NTIS HC/MF A01

The Center for Analysis of Particle Scattering (CAPS) in the Department of Physics at Virginia Polytechnic Institute and State University has analyzed basic two-body hadron reactions below 2 GeV for the last two decades. Reactions studied were nucleon-nucleon, pion-nucleon, K(+)-nucleon, and pion photoproduction systems. In addition to analyses of these systems, a computer graphics system (SAID) has been developed and disseminated to over 250 research institutions using VAX computers. The computer-interactive system for disseminating information on basic scattering reactions is also accessible to the physics community through TELNET on the VPI&SU physics department VAX. DOE

N92-19854# Ames Lab., IA.
DEEP INELASTIC PROCESSES WITH BACKWARD HADRONS
C. E. Carlson, K. E. Lassila, and U. P. Sukhatme (Illinois Univ., Chicago.) 1991 4 p Presented at the Conference on the Intersections Between Particle and Nuclear Physics, Tucson, AZ, 23-29 May 1991
(Contract W-7405-eng-82)
(DE92-005148; IS-M-680; CONF-9105106-36) Avail: NTIS HC/MF A01

We examine consequences of probing the deuteron and heavier nuclei for six quark components. We find kinematical limits exist on backward hadron production and deduce backward momentum distributions which are in agreement with CERN and Fermilab neutrino experiments on deuterium and nuclear targets. DOE

N92-19893# Pittsburgh Univ., PA.
LABORATORY STUDIES OF ATOMIC COLLISION PROCESSES Final Report, 1 Apr. 1987 - 30 Jun. 1991
Rainer Johnsen 15 Aug. 1991 5 p
(Contract DAAL03-87-K-0048)
(AD-A244396; ARO-24468.10-PH) Avail: NTIS HC/MF A01 CSCL 04/1

This research program has dealt with atomic collision processes of interest for models of natural or man-made plasmas, such as electrical discharge devices, gas lasers, and atmospheric plasmas. Specific topics have included: (1) Electron-ion recombination of NO(+), O4(+) and N4(+) ions, preparation of data compilations on electron-ion recombination; (2) experimental measurements of rates of neutral-stabilized electron-ion recombination; (3) experimental measurements of recombination of positive with negative ions; and (4) experimental and theoretical work on ion-atom and ion-molecule elastic and reactive collisions, and laser-induced charge-transfer reactions. GRA

N92-19894# Washington Univ., Seattle. Dept. of Physics.
PARTICLE PHYSICS: EXPERIMENTAL
Jere J. Lord, P. E. Boynton, T. H. Burnett, and R. J. Wilkes 21 Aug. 1991 52 p
(Contract DE-FG06-91ER-40614)
(DE92-004253; DOE/ER-40614/8) Avail: NTIS HC/MF A04

We are continuing a research program in particle astrophysics and high energy experimental particle physics. We have joined the DUMAND Collaboration, which is constructing a deep undersea astrophysical neutrino detector near Hawaii. Studies of high energy hadronic interactions using emulsion chamber techniques were also continued, using balloon flight exposures to ultra-high cosmic ray nuclei (JACEE) and accelerator beams. As members of the DUMAND Collaboration, we are responsible for the development and construction of critical components for the deep undersea neutrino detector facility. We have designed and developed the acoustic positioning system required to permit reconstruction of muon tracks with sufficient precision to meet the astrophysical goals of the experiment. In addition, we are making significant contributions to the design of the database and triggering system to be used. Work has been continuing in other aspects of the study of multiparticle production processes in nuclei. We are participants in a joint US/Japan program to study nuclear interactions at energies two orders of magnitude greater than those of existing accelerators. The program uses balloon-borne emulsion chambers. On one of the flights we found two nuclear interactions of multiplicity over 1000 - one with a multiplicity of over 2000 and pseudorapidity density (approximately) 800 in the central region. At the statistical level of the JACEE experiment, the frequency of occurrence of such events is orders of magnitude too large. We have continued our ongoing program to study hadronic interactions in emulsions exposed to high energy accelerator beams. DOE

N92-19935# Texas Univ., Austin. Dept. of Physics.
STUDIES IN MEDIUM ENERGY PHYSICS: ADDENDUM
A. Green, G. W. Hoffmann, J. McDonough, M. J. Purcell, R. L. Ray, D. E. Read, and S. D. Worn Dec. 1991 94 p
(Contract DE-FG05-88ER-40444)
(DE92-006451; DOE/ER-40444/4-Add) Avail: NTIS HC/MF A05

This document constitutes the (1991--1992) technical progress report and continuation proposal for the ongoing medium energy nuclear physics research program supported by the U.S. Department of Energy through special Research Grant DE-FG05-88ER-40444. The experiments discussed are conducted at the Los Alamos National Laboratory's (LANL) Clinton P. Anderson Meson Physics Facility (LAMPF) and the Alternating Gradient Synchrotron (AGS) facility of the Brookhaven National Laboratory (BNL). The overall motivation for the work discussed in this document is driven by three main objectives: (1) provide hadron-nucleon and hadron-nucleus scattering data which serve to facilitate the study of effective two-body interactions, test (and possibly determine) nuclear structure, and help study reaction mechanisms and dynamics; (2) provide unique, first-of-a-kind

'exploratory' hadron-nucleus scattering data in the hope that such data will lead to discovery of new phenomena and new physics; and (3) perform precision tests of fundamental interactions, such as rare decay searches, whose observation would imply fundamental new physics. DOE

N92-20002# Oak Ridge National Lab., TN.
INTRUDER STATES AND LOW ENERGY NUCLEAR SPECTROSCOPY
R. Bengtsson (Oak Ridge Associated Universities, Inc., TN.) 1991 19 p Presented at the Nuclear Shapes and Nuclear Structure at Low Excitation Energies, Cargese (France), 3-7 Jun. 1991
(Contracts DE-AC05-84OR-21400; DE-AC05-76OR-00033)
(DE92-005432; CONF-9106196-5) Avail: NTIS HC/MF A03

The crucial role intruder orbitals play is not limited to low spin and small deformations. In fact much of the physics at superdeformed shapes and at very high spin is a direct result of the presence of high-j intruder orbitals in the vicinity of the Fermi surface, including the introduction of intruder orbitals from still higher shells at extreme deformations. Since the intruder subshell has a larger angular momentum (j) than any other subshell close to the Fermi surface it plays an essential role for building up angular momentum in the nucleus, and the alignment of intruder shell (quasi) particles is responsible for a large variety of bandcrossings observed in discrete spectroscopy along or near the yrast line. Intruder shell orbitals are also associated with large quadrupole moments and the occupation of these orbitals may lead to significant changes of the deformation of the nucleus. Under favorable circumstances a nucleus may have totally different shapes depending on the occupation of the intruder orbitals, giving rise to a phenomenon which is usually referred to as shape coexistence. In this paper, shape coexistence in several mass regions are discussed with specific attention focused on the relation between shape coexistence and the occupation of intruder shell levels. Shape effects associated both with spin aligned and non-aligned intruder orbitals are investigated. DOE

N92-20030*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
RADIATIVE ENERGY TRANSFER IN MOLECULAR GASES Report, Dec. 1991
Surendra N. Tiwari Feb. 1992 245 p
(Grant NAG1-363)
(NASA-CR-190057; NAS 1.26:190057; ODU/ICAM-92-101)
Avail: NTIS HC/MF A11 CSCL 20H

Basic formulations, analyses, and numerical procedures are presented to study radiative interactions in gray as well as nongray gases under different physical and flow conditions. After preliminary fluid-dynamical considerations, essential governing equations for radiative transport are presented that are applicable under local and nonlocal thermodynamic equilibrium conditions. Auxiliary relations for relaxation times and spectral absorption models are also provided. For specific applications, several simple gaseous systems are analyzed. The first system considered consists of a gas bounded by two parallel plates having the same temperature. Within the gas there is a uniform heat source per unit volume. For this system, both vibrational nonequilibrium effects and radiation conduction interactions are studied. The second system consists of fully developed laminar flow and heat transfer in a parallel plate duct under the boundary condition of a uniform surface heat flux. For this system, effects of gray surface emittance are studied. With the single exception of a circular geometry, the third system is considered identical to the second system. Here, the influence of nongray walls is also studied. Author

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N92-19206 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
HIGH-POWER PULSED ION SOURCES [MOSHCHNYE IMPULSNYE ISTOCHNIKI IONOV]
V. M. Vystritskii and Ia. E. Krasik 1990 37 p In RUSSIAN
Copyright Avail: Issuing Activity

This article presents a summary of the state of the art of experimental work connected with the development of high-current accelerators, ion diodes, and sources of anode plasma. The fundamental direction of research, directed toward an increase in output power of the high-voltage pulse accelerator is examined. An analysis is conducted of various schemes of ion diodes, their strengths and weaknesses, and the possibility of an increase in efficiency of the generator for their power ion beams. Problems connected with the establishment and use of homogeneous dense anode plasma, which is the source of ions, are analyzed. The characteristic traits of various types of passive and active sources of anode plasma are presented. Transl. by L.K.H.

N92-19528# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Engineering Energie- und Anlagentechnik Werkstofftechnologie.
SIMULATION OF SHUTDOWN AND STORAGE CONDITIONS FOR ACTIVATED CARBON/TZM-Mo.41Re NET DIVERTOR COMPONENTS
Geert Weimann and Ivica Smid Apr. 1991 28 p
(OEFZS-4573; ETN-92-90642) Copyright Avail: NTIS HC/MF A03

Evaluation of the overall activation and the decay heat produced in a divertor is studied. The decay heat could possibly melt the braze joints. The cooling provisions required for the time to remove the divertor elements form the fusion reactor and the period of long term storage are estimated. Activated divertor plates of carbon/TZM-Mo.41Re need to be stored in a shielded control area. Various cooling regimes and provisions are described. The current divertor design does not include considerations of single/double cooling circuits. How to avoid excessive heatup under severe accident conditions is identified as an area needing further research. ESA

N92-19560# Brookhaven National Lab., Upton, NY.
DESIGN AND OPERATION OF THE AGS BOOSTER IONIZATION PROFILE MONITOR
A. N. Stillman, R. E. Thern, W. H. VanZwienen, and R. L. Witkover 1991 10 p Presented at the Accelerator Instrumentation Workshop, Newport News, VA, 28-31 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-004987; BNL-46827; CONF-9110118-3) Avail: NTIS HC/MF A02

The AGS Booster Ionization Profile Monitor (IPM) must operate in a vacuum of about 3 x 10(exp -11) Torr. The ultra-high vacuum imposes certain requirements on detector gain and restrictions on construction techniques. Each detector is a two-stage micro-channel plate with an integral substrate containing sixty-four printed anodes. Formed electrodes provide uniform collection fields without the use of resistors, which would be unacceptable in these vacuum conditions. An ultra-violet light calibrates the detector in its permanent mounting. An extra set of electrodes performs a first order correction to the perturbations imposed by the horizontal and vertical collection electrodes. This paper will present details of the design of the profile monitor and recent operational results. DOE

N92-19608# Dartmouth Coll., Hanover, NH.
TIME DEPENDENCE OF HEAVY ION CONCENTRATION IN THE RING CURRENT

Mary K. Hudson 9 Sep. 1991 12 p
(Contract F19628-87-K-0038)
(AD-A243954; PL-TR-91-2234; SR-1) Avail: NTIS HC/MF A03 CSCL 20/7

The focus of this project was a comprehensive study of processes responsible for the decay of the storm time ring current. We have examined ring current ion loss from interaction with waves in the Pc 1 (Hz) and Pc 5 (mHz) frequency ranges, since such waves are a common feature of the ring current region during recovery from magnetic storms. Pc 1 waves, identified as electromagnetic ion cyclotron (EMIC) waves, are generated by the loss cone distribution of ring current ions. Both linear dispersion analysis and particle simulations show the importance of the loss cone vs. bi-Maxwellian nature of ring current ion distributions in determining the growth rate, angle of propagation, and polarization of EMIC waves. Pitch angle diffusion is found to be an important loss process for ring current H(+). Compressional Pc 5s are found to contribute to ring current 0(+) loss. Their frequency (2-5 mHz) is comparable to the bounce frequency of ring current 0(+). We have performed ring current test particle simulations in prescribed wave and background fields, including a dipole magnetic convection and corotation electric field. We find that a drift-bounce resonant interaction causes ring current 0+ loss to the magnetopause in the energy range of a few tens of keV for moderate kp (1.5-2). GRA

N92-19944# Fermi National Accelerator Lab., Batavia, IL.
SHOCK WAVES IN P-BAR TARGET
Zhijing Tang and K. Anderson Nov. 1991 29 p
(Contract DE-AC02-76CH-03000)
(DE92-007031; FNAL-TM-1763) Avail: NTIS HC/MF A03

The deposition of a large amount of beam energy in a short time will cause high temperature and pressure in the center of a P-bar target, and this disturbance will propagate outwards as a shock wave. Shock wave induced material changes which are our concern include void growth and accompanying density decrease which will decrease antiproton yield. Crack formation and fracture in the tungsten target will destroy the integrity of the target. Our objective is to analyze the shock wave behavior in the target, optimize its design so that the destructive effects of shock wave can be minimized, the integrity of the target can be maintained, and a reasonably high yield of antiproton production can be achieved. In this report we put together some results of our analysis of a cylindrical copper target. We hope that it will provide a general overview of the shock wave phenomena in the target, establish a basis for further research, and facilitate the target design. First, energy deposition data are analyzed, and it is justified that as an approximation, the problem can be treated as axisymmetric. The average data therefore are used as energy profile. However, the maximum energy deposition is still used as the peak value. Next some basic estimations are made as to what temperature and pressure can reach at the present level of energy deposition. Then some characteristics of wave propagation in a thermal shock loaded solid are illustrated with a one-dimensional model. Since there is no analytical solution available for cylindrical geometry, our understanding of the problem relies on a numerical model, which is performed via the finite element package ANSYS. Results of numerical analysis are summarized, sources of potential danger are identified, and design ideas to minimize the damage are proposed. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N92-19026# Los Alamos National Lab., NM.
FIBER OPTIC GEOPHYSICAL SENSORS Patent Application
E. F. Homuth, inventor (to DOE) 10 Apr. 1990 16 p
(Contract W-7405-eng-36)
(DE92-003875; US-Patent-Appl-SN-506741; Patents-US-A7506741) Avail: NTIS HC/MF A03

This invention is comprised of a fiber optic geophysical sensor in which laser light is passed through a sensor interferometer in contact with a geophysical event, and a reference interferometer not in contact with the geophysical event but in the same general environment as the sensor interferometer. In one embodiment, a single tunable laser provides the laser light. In another embodiment, separate tunable lasers are used for the sensor and reference interferometers. The invention has such uses as the monitoring of earthquakes and the weighing of objects. DOE

N92-19076# Quest Integrated, Inc., Kent, WA.
A PROFILING FIBER-OPTIC DIODE LASER DOPPLER VELOCIMETER FOR DEPLOYMENT IN COASTAL WATERS: PROTOTYPE DEVELOPMENT, PHASE 2 Final Report, 28 Sep. 1989 - 30 Sep. 1991
H.-T. Liu, P. D. Bondurant, W. T. Gustafson, M. H. Marvin, and R. A. Srnsky Nov. 1991 71 p
(Contract N00014-89-C-0308)
(AD-A244066; QUEST-TR-536-Phase-2) Avail: NTIS HC/MF A04 CSCL 20/6

A prototype profiling a fiber-optic diode laser Doppler velocimeter (FODLDV) for flow measurement in coastal waters was developed, fabricated, and tested. The two-velocity-component FODLDV, a backscattered version of a field proven diode laser Doppler velocimeter (DLDV), consists of a fiber-optic probe and link, an optronic module, a digital fast Fourier transform (FFT) based signal processor, and a data acquisition and control system (DACS). The fiber-optic probe and link are mounted on a traverse that facilitates velocity profiling up to a maximum range of 3 m. The 1.6-cm diameter probe houses the collimating lenses attached to three single-mode polarizing preserving fibers, the focusing/receiving lenses, and a multimode fiber. The four 12-m-long optic fibers, protected in a water-tight armor cable, serve as the optical link between the probe and the module; the single mode fibers transmit the frequency-shifted laser beams to the probe, and the multimode fiber transmits the backscattered light back to the photodetector. Command files allow all the operational parameters of the signal processor and the traverse to be modified on-the-fly. To operate the profiling FODLDV in an autonomous mode, a command file may be set up and executed to conduct an experimental sequence lasting for days, limited only by the capacity of the hard disk. GRA

N92-19089# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ANALOG PROCESSING OF OPTICAL WAVEFRONT USING INTEGRATED GUIDED-WAVE OPTICS Annual Report, 1 Jun. 1990 - 30 Jun. 1991
Robert H. Rediker 9 Oct. 1991 22 p
(Contract F49620-90-C-0036)
(AD-A244421; AFOSR-91-1009TR) Avail: NTIS HC/MF A03 CSCL 20/6

Integrated Guided-Wave Optics has many advantages for the analog processing of optical wavefronts. These include small-size, high-speed, simplicity, reliability, and reproducibility. The fabrication technique is similar to that of integrated circuits. The thrust of this program is to develop an integrated guided-wave optic system, in GaAs and GaAlAs for use at GaAs laser wavelength to remove aberrations from a laser beam and to steer the beam. The system would in addition have the capability to appropriately phase the outputs from a multiplicity of power amplifiers or injection-locked lasers. It is also the intent of the program to design and build the optical circuits so they are compatible with on-chip electronic circuits in order to minimize the required number of off-chip leads. GRA

N92-19094# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INFRARED TARGET RECOGNITION M.S. Thesis
Brian D. Singstock Dec. 1991 83 p
(AD-A243888; AFIT/GE/ENG/91D-49) Avail: NTIS HC/MF A05 CSCL 17/5

In this thesis, three approaches were used for Automatic Target

Recognition (ATR). These approaches were shape, moment and Fourier generated features, Karhunen-Loeve Transform (KLT) generated features and Discrete Cosine Transform (DCT) generated features. The KLT approach was modelled after the face recognition research by Suarez, AFIT, and Turk and Pentland, MIT. A KLT is taken of a reduced covariance matrix, composed all three classes of targets, and the resulting eigenimages are used to reconstruct the original images. The reconstruction coefficients for each original image are found by taking the dot product of the original image with each eigenimage. These reconstruction coefficients were implemented as features into a three layer backprop with momentum network. Using the hold one-cut-out technique of testing data, the net could correctly differentiate the targets 100 percent of the time. Using standard features, the correct classification rate was 99.33 percent. The DCT was also taken of each image, and 16 low frequency Fourier components were kept as features. These recognition rates were compared to FFT results where each set contained the top five feature, as determined by a saliency test. The results proved that the DCT and the FFT were equivalent concerning classification of targets. GRA

N92-19169# Rome Lab., Griffiss AFB, NY.
TIME-DIVISION OPTICAL INTERCONNECTS FOR LOCAL-AREA AND MICRO-AREA NETWORKS
Mark F. Krol, Raymond K. Boncek, Steven T. Johns, and John L. Stacy Dec. 1991 64 p
(AF Proj. 4600)
(AD-A244343; RL-TR-91-398) Avail: NTIS HC/MF A04 CSCL 20/6

This report describes the development of an optical Time-Division Multiple-Access (TDMA) interconnect suitable for applications in local-area and micro-area networks. The advantages of using time-division techniques instead of frequency-division, wavelength-division, or code-division techniques in a shared-medium environment are discussed in detail. Furthermore, a detailed description of the TDMA architecture is presented along with various experiments pertaining to the actual components needed to implement the system. Finally, experimental data is presented for an actual optical TDMA test bed. The experimental data demonstrates the feasibility of the architecture, and shows that currently the system has the capability to accommodate up to 50 channels. The bit-error-rate per channel was measured to be less than 10(exp -9) for pseudo-random bit-sequences. GRA

N92-19193# Rome Lab., Griffiss AFB, NY.
MATERIAL EFFECTS IN PHOTOCONDUCTIVE FROZEN WAVE GENERATORS Report, 1 Jun. 1989 - 30 Sep. 1989
Robert M. OConnell, J. B. Thaxter, and Richard E. Bell Apr. 1991 35 p
(AD-A244140; RL-TR-91-88) Avail: NTIS HC/MF A03 CSCL 20/6

Linear photoconductive gallium arsenide (GaAs) fast closing switches for microwave applications, such as frozen wave pulse generation, are analyzed and compared to experimental measurements. Material effects in photo-conductive frozen wave generators fabricated in semiconductor-based microstrip transmission line are studied from three perspectives; frozen wave propagation in the line; the spacing between the switches in a frozen wave generator and their maximum number; and the switching behavior of the gap-switch itself, which is modeled as a lumped-element, modified Ebers-Moll equivalent circuit. The experimental transient behavior of hybrid gap-switches fabricated on semi-insulating GaAs with ohmic and non-ohmic contacts is compared with predicted performance. Picosecond laser pulses, doubled to 527 micron wavelength are used to excite linear photoconductivity in 75 micron gap switches mounted in a test fixture of 50 ohm microstrip lines on alumina. GRA

N92-19209 Department of the Navy, Washington, DC.
MONOLITHIC OPTICAL PROGRAMMABLE SPECTROGRAPH (MOPS) Patent
Paul B. Dorain, inventor (to Navy) and Judith B. Snow, inventor (to Navy) 25 Jun. 1991 4 p Filed 4 Oct. 1989
(AD-D015113; US-Patent-5,026,160; US-Patent-Appl-SN-417623; US-Patent-Class-356-328) Avail: US Patent and Trademark Office CSCL 14/2

A solid monolithic spectrograph utilizes the Czerny-Turner geometric configuration. It has a base constructed of BK7 optical glass to which all components are affixed with optical epoxy. The compact spectrograph operates in the visible spectrum in second order thereby permitting it to be smaller by a factor of two than if it operated in first order. The spectrograph is programmable and is capable of simultaneous multichannel measurements of wavelengths and bandwidths of sources in the visible and near infrared spectral regions. Author (GRA)

N92-19286# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN ANALYSIS OF ONE-DIMENSIONAL MODELS OF THE INSULATING AND CONDUCTING PRIZ M.S. Thesis
Joseph W. Cook, III Dec. 1991 113 p
(AD-A244123; AFIT/GEP/ENP/91D-2) Avail: NTIS HC/MF A06 CSCL 20/6

The PRIZ is an optical storage device that offers great promise in optical computing and image processing. The term PRIZ is a Soviet acronym for Preobrasovatel Izobrazheniya which translates as 'image transformer.' This study will investigate computer models of various configurations of the PRIZ. The output from these models will be compared to previously reported experimental and analytical work, and the results of these comparisons will be used to further our understanding of the basic physical processes governing the operation of the PRIZ. The PRIZ consists of a single crystal of photorefractive material mounted between two transparent electrodes which are biased at several kilovolts. A writing light beam impinges on the crystal through one of the transparent electrodes. In general, the write light is perpendicular to the crystal face and impinges from the direction of the negative electrode, although other configurations have been used. GRA

N92-19358# Sandia National Labs., Albuquerque, NM.
INFRARED DEGENERATE FOUR-WAVE MIXING AS A DIAGNOSTIC
R. L. VanderWal, R. L. Farrow, D. J. Rakestraw, B. E. Holmes, J. B. Jeffries (SRI International Corp., Menlo Park, CA.), and P. M. Danehy 1991 4 p
(Contract DE-AC04-76DR-00789)
(DE92-005331; SAND-91-8703) Avail: NTIS HC/MF A01

We are currently exploiting the recently realized spectroscopic capabilities of degenerate four-wave mixing (DFWM) to probe key combustion species by employing infrared rovibrational transitions to achieve resonant enhancement. DOE

N92-19371# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
HYBRID OPTICAL INFERENCE MACHINES Final Report, 15 Aug. 1986 - 14 Feb. 1991
Cardinal Ware, James Kottas, and Vernon Shrauger 27 Sep. 1991 92 p
(Grant AF-AFOSR-0301-86; AF Proj. 5780)
(AD-A243985; AFOSR-91-0999TR) Avail: NTIS HC/MF A05 CSCL 20/6

This program has investigated the use of limit cycles to represent and process symbolic information in the context of an inference machine. This approach was proposed as a means of overcoming problems with fault tolerance and relatively small space-bandwidth products in current spatial light modulator (SLM) technology. The program has focused on developing a storage medium with many limit cycles (oscillatory modes) available and a method for coupling the various modes in a desired way. Because of their flexibility, neural network ideas were used as the basis for the components and algorithms developed. In the theoretical realm, the program has had many accomplishments. First, the self-oscillating neural network (SONN) model was developed and characterized as the oscillatory medium. This model was designed with optical spatial SLMs in mind and does not require any training

or programming. Furthermore, it is highly tolerant of static parameter variations inherent in the optics. Next, the spectral back-propagation (SBP) training algorithm was developed with complete generality as a means of forming the coupling trajectories. This algorithm trains input-output sequences into a network using an error criterion based on a Fourier series decomposition of the sequences. The method allows the interconnects to have trainable time delays in addition to the weights. GRA

N92-19448# Rensselaer Polytechnic Inst., Troy, NY.
MICROCOMPUTER ENHANCED OPTICAL INVESTIGATION OF SPREADING AND EVAPORATIVE PROCESSES IN ULTRA THIN FILMS
P. C. Wayner, Jr. and A. H. Liu Dec. 1991 16 p
(Contract DE-FG02-89ER-14045)
(DE92-005085; DOE/ER-14045/5) Avail: NTIS HC/MF A03

The general objective of the research is to determine the heat transfer characteristics of evaporating ultra-thin films. The immediate objective is to develop a microscopic image-processing system (IPS) to measure the film thickness profile. The IPS has two parts: an image analyzing interferometer (IAI) and an image analyzing ellipsometer (IAE). An IAI was designed and used to measure the thickness profiles of an extended meniscus in the contact line region of completely wetting liquid films. Both steady state and oscillating menisci were studied. We find that the convenience and efficiency of mirocomputer enhanced video microscopy naturally leads to a better understanding of the transport processes in the contact line region. We also find that the processes of change-of-phase heat transfer and fluid flow in thin films are intrinsically connected because of their common dependence on the intermolecular force field. The design of an image analyzing ellipsometer (IAE) was completed and the system was successfully tested by measuring the thickness and refractive index profiles of various solid films of known thicknesses. The profile of draining isothermal films will be measured next. DOE

N92-19459# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
REPRESENTATIONS OF 3-D SCATTERING MATRICES Final Report, Jun. - Jul. 1989
Jerold R. Bottiger Nov. 1991 22 p
(AD-A243961; CRDEC-TR-291) Avail: NTIS HC/MF A03
CSCL 20/6

The standard Mueller matrix formalism in which the incident light beam and all scattered light beams lie in a single plane is extended to 3-D geometry. This study shows that there are two matrix representations, which are appropriate for describing light scattering in unrestricted directions, that are related to each other by the rotation matrix. One matrix is better suited for characterization of the scatterer, and the other performs the traditional Mueller matrix function of relating outgoing Stokes vectors to the incident Stokes vector. GRA

N92-19470# Lawrence Livermore National Lab., CA.
X RAY IMAGING SYSTEM Patent Application
G. E. Sommargren, inventor (to DOE) and H. J. Weaver, inventor (to DOE) 30 Apr. 1990 20 p
(Contract W-7405-eng-48)
(DE92-003830; US-Patent-Appl-SN-516401; Patents-US-A7516401) Avail: NTIS HC/MF A03

The invention provides a method and apparatus for focusing and imaging x-rays. An opaque sphere is used as a diffractive imaging element to diffract x-rays from an object. The divergent x-ray wavefronts are then transformed into convergent wavefronts. The convergent wavefronts are brought into focus to form an image of the object. The new image has a large depth of field. DOE

N92-19562 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
METHODOLOGICAL ISSUES OF OPTICAL SPECTRA STUDIES [METODOLOGICHESKIE OSOBENNOSTI IZUCHENIIA OPTICHESKIKH SPEKTROV]
B. M. Nitsovich and V. D. Falenchuk 1989 41 p In RUSSIAN
Copyright Avail: Issuing Activity

In this work a study is conducted of the optical properties of three-component systems: the exciton-photon-phonon. Various theoretical approaches to the study of the exciton spectrum are investigated, including the Green's functions method, the method of inverse spectra problems, and the method of moments. The temperature dependences of the spectral characteristics of an exciton are analyzed. Transl. by L.K.H.

N92-19606# Sparta, Inc., Lexington, MA.
BACKSCAT LIDAR BACKSCATTER SIMULATION: USER'S GUIDE FOR VERSION 2.0
J. R. Hummel, D. R. Longtin, N. L. Paul, and J. R. Jones 11 Jul. 1991 65 p
(Contract F19628-88-C-0038)
(AD-A243949; PL-TR-91-2181; SR-10) Avail: NTIS HC/MF A04
CSCL 20/6

BACKSCAT is a computer simulation of atmospheric backscatter from a laser radar (lidar) system. The computer code can simulate operating conditions for a variety of viewing, laser system, and atmospheric conditions. BACKSCAT Version 2.0 has been totally redesigned. The redesign effort has included the addition of several new features as well as improvements to the code. As with Version 1.0, BACKSCAT Version 2.0 is modular in design. This allows for further expansion and growth in the code. Wind dependent desert aerosols and cirrus clouds have been added. Both are based on formulation used in LOWTRAN 7. The cirrus cloud models include standard cirrus clouds as well as subvisual clouds. An all new User Interface System has also been developed. The new interface is designed to be easy to use while providing the operator with maximum flexibility. The interface system includes a built-in graphics package that permits the user to display the results from a simulation. The interface system also permits the user to include molecular scattering profiles based on a library of built-in model atmospheres or a user-supplied radiosonde profile. GRA

N92-19789# Alabama Univ., Huntsville. Dept. of Physics.
ANALYSIS OF POLARIZING OPTICAL SYSTEMS FOR DIGITAL OPTICAL COMPUTING WITH SYMMETRIC SELF ELECTROOPTIC DEVICES Final Report, 1 Sep. 1989 - 30 Sep. 1991
Russell A. Chipman and Joseph L. Pezzaniti 4 Nov. 1991 138 p
(Grant AF-AFOSR-0542-89; AF Proj. 2305)
(AD-A244002; AFOSR-91-1002TR) Avail: NTIS HC/MF A07
CSCL 20/6

This research developed imaging polarimetry to study the propagation of polarized light in polarization based optical interconnects such as the AT&T digital optical computer, and adapted polarization aberration theory and polarization ray tracing, to understand new classes of problems arising in optical systems for digital optical computing. An imaging polarimeter was constructed and calibrated at UAH under this contract. The output is a Mueller matrix image, a spatial representation of the polarization properties across a wavefront, typically as a function of field of view or pupil coordinate. With the imaging polarimeter, one can simultaneously balance the transmitted polarization between the top and bottom, and left and right sides of a wavefront as one rotates, tilts, or otherwise adjusts the polarization components. The imaging polarimeter was demonstrated to be a useful alignment tool and was used to characterize many polarizing elements such as polarizing beam splitters, linear retarders, and liquid crystals. GRA

N92-19870# Lawrence Livermore National Lab., CA.
HIGH POWER FIBER OPTIC DELIVERY SYSTEMS
R. E. English, Jr. and S. A. Johnson Mar. 1992 6 p Presented at the DOD Fiber Optics Conference, McLean, VA, 25 Mar. 1992
(Contract W-7405-eng-48)

(DE92-007348; UCRL-JC-108892; CONF-920367-3) Avail: NTIS HC/MF A02

We present a system architecture for a high power fiber optic delivery system to deliver the laser power from many sources to many destinations. For our application, the sources are copper vapor laser chains and the destinations are dye laser amplifiers. By means of this fiber delivery architecture, the delivery system can be configured conveniently in a fully redundant fashion. In this system, the light arriving at every destination includes an equal fraction from every source. We also describe the functions of the opto-mechanical components necessary for implementation of this architecture. DOE

N92-19980# Argonne National Lab., IL.
CONSTRAINED LINEAR INVERSION OF LIGHT SCATTERED FROM NON-ABSORBING, NEARLY IDENTICAL SPHERICAL PARTICLES FOR SIZE AND REAL REFRACTIVE INDEX
M. R. Jones, M. Q. Brewster (Illinois Univ., Urbana.), and B. P. Curry 1991 9 p Presented at the Annual CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen Proving Ground, MD, 24-27 Jun. 1991
(Contract W-31-109-eng-38)
(DE92-005220; ANL/CP-73267; CONF-9106259-2) Avail: NTIS HC/MF A02

The Fredholm equation of the first kind representing the light scattering by a narrow log normal distribution of non-absorbing aerosol particles is inverted to obtain the particle size distribution function and real refractive index. The deconvolution technique is a generalization of the process previously developed to obtain particle size distribution functions when the optical properties of the particles are known. The solution is obtained by expanding the scattering kernels and the particle size distribution function as linear combinations of Schmidt-Hilbert eigenfunctions. The orthogonality properties of the Schmidt-Hilbert eigenfunctions and of the eigenvectors of the kernel covariance matrix are employed to obtain a solution which minimizes the residual errors subject to a trial function constraint. Application of the trial function constraint requires prior knowledge of the type of distribution. The inversion process is described briefly, and the results from the inversion of several synthetic data sets are presented. It is anticipated that future improvements in the technique will result in a quantitative analysis of the error in the size distribution and in the value obtained for the real refractive index. Optimization of the inputs should lead to a reduction in the number of measurements required for a successful inversion. Also, it is anticipated that further generalization will allow for the retrieval of the imaginary part of the refractive index. DOE

N92-20042# Naval Postgraduate School, Monterey, CA.
RECONSTRUCTION OF COMPUTER SIMULATED, ATMOSPHERIC TURBULENCE-DEGRADED, ASTRONOMICAL OBJECTS BY APPLICATION OF THE KNOX-THOMPSON AND TRIPLE-CORRELATION PHASE RECOVERY TECHNIQUES M.S. Thesis
James M. Lackemacher Dec. 1990 189 p
(AD-A243127) Avail: NTIS HC/MF A09 CSCL 20/6

Atmospheric turbulence severely degrades images of astronomical objects. Providing images that accurately reflect the true nature of these objects is essential to their understanding. Several object recovery techniques exist within the field of speckle imaging that produce accurate representations of astronomical objects. This thesis provides an in-depth comparison of two such techniques, Knox-Thompson and triple-correlation. Through computer simulation, this thesis accurately compares the abilities of both recovery techniques to enhance turbulence degraded objects by exploiting the diffraction-limited information contained in short exposure, or speckle, images. The simulation produced these images by creating an object and several phase screens which simulated the effects of turbulence. Together, the object and the appropriate quantity of phase screens yielded the required short exposure images. Application of the Knox-Thompson and triple-correlation techniques to identical sets of these degraded images produced the resulting reconstructed objects, their signal-to-noise ratios and their azimuthal RMS phase errors. Comparison of these three factors over several imaging criteria concluded that the superior phase recovery technique was triple-correlation. GRA

N92-19309*# Towson State Univ., MD. Dept. of Physics.
REFLECTION EFFECTS IN MULTIMODE FIBER SYSTEMS UTILIZING LASER TRANSMITTERS
Harry E. Bates *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 65-115 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 20F

N92-19324*# State Univ. of New York, Albany. Dept. of Electrical Engineering.
EVALUATION AND ANALYSIS OF THE ANSI X3T9.5 (FDDI) PMD AND PROPOSED SMF-PMD AS INFLUENCED BY VARIOUS FIBER LINK CHARACTERISTICS
M. Chris Wernicki *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 554-595 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-19211 Department of the Navy, Washington, DC.
BULK PLASMA GENERATION Patent
Han S. Uhm, inventor (to Navy), Joel D. Miller, inventor (to Navy), Ralph F. Schneider, inventor (to Navy), and Daniel J. Weidman, inventor (to Navy) 24 Sep. 1991 7 p Filed 30 Jan. 1991
(AD-D015118; US-Patent-5,051,659; US-Patent-Appl-SN-647903; US-Patent-Class-315-111.41) Avail: US Patent and Trademark Office CSCL 20/9

Annular arrangements of thermionic filaments adjacent opposite axial ends of a chamber within which argon gas at low pressure is confined, generate steady state plasma with uniformity by low energy emission of gas ionizing electrons from the filaments. The ionizing electrons and plasma generated are axially confined between grids at the axial ends of the chamber and radially confined by a low intensity magnetic field generated by an external magnetic coil. GRA

N92-19449# Johns Hopkins Univ., Baltimore, MD.
SPECTROSCOPIC DIAGNOSTICS OF HIGH TEMPERATURE PLASMAS, JANUARY 1, 1991 - DECEMBER 31, 1991
1991 4 p
(Contract DE-FG02-86ER-53214)
(DE92-005087; DOE/ER-53214/3) Avail: NTIS HC/MF A01

During 1991, the activities of the John Hopkins University Plasma Spectroscopy Group have covered several areas of research, in the domain of XUV spectroscopy of magnetically confined fusion plasmas. While the main effort concentrated on the development of novel diagnostics which utilize Layered Synthetic Microstructures (LSM's) as the dispersive/filtering elements, work has been done in the area of detector development and the physics of the tokamak edge plasma. An XUV monochromator for the 20-200 A range, which uses flat LSM's, has been built and is currently operated on the D3-D tokamak at General Atomics in San Diego. A design for a follow-up experiment at D3-D is now in progress. As a preliminary step toward tokamak plasma imaging in the XUV wavelength range using curved LSM coated substrates, a prototype XUV camera was built and operated in our laboratory in image the A1 3 emission at lambda-175 A from a Penning Ionization Discharge Plasma. Based on these laboratory results, the design of the XUV camera, which will image plasma in the Phaedrus T tokamak O 6 emission (150 A), has

been completed. This instrument is presently under construction. Also a detailed design of a system composed of four LSM based imaging devices for N(sub e)(0) and T(sub e)(0) fluctuation measurements on TEXT has been completed. The accuracy and the uniformity of the LSM coatings on flat and small curved surfaces used in the above-mentioned instruments have been evaluated in our laboratory using an in-house built calibration facility and at the SURF II synchrotron at the National Institute of Standards and Technology. DOE

N92-19477# Ballistic Research Labs., Aberdeen Proving Ground, MD.

ELECTRICAL ENERGY SHAPING FOR BALLISTIC APPLICATIONS IN ELECTROTHERMAL GUNS Final Report, Nov. 1989 - Sep. 1990

G. L. Katulka, H. Burden, A. Zielinski, and K. White Dec. 1991 24 p

(AD-A243850; BRL-TR-3304) Avail: NTIS HC/MF A03 CSCL 19/6

A five-stage, 130-kJ pulse forming network (PFN) for delivering electrical energy to an experimental ETC (electrothermal chemical) gun is described. The device is fundamentally a network of RLC circuits where the load, R, is either a fixed-metallic or variable-plasma resistance. Capacitors provide long-term energy storage, inductors are used for pulse shaping, ignitrons are used as closing switches, and power diodes serve as 'clamping' diodes to protect the capacitors from voltage reversal during operation. Linear theory network simulations of circuits discharge into the fixed load within an energy range of 1.4 to 22.0 kJ are in close agreement with experiment. Resistance measurements of plasmas generated using this PFN indicate that plasma resistance is a strong function of current. It is linear with capillary length and inversely proportional to capillary diameter. Loss of diodes during operation was frequent. The probable cause of this problem and circuit revisions to reduce diode stresses are described. GRA

N92-19509# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

PLASMA TRANSPORT IN A MAGNETIC MULTICUSP NEGATIVE HYDROGEN ION SOURCE Ph.D. Thesis

Ricky G. Jones Dec. 1991 243 p

(AD-A243876; AFIT/DS/ENP/91-02) Avail: NTIS HC/MF A11 CSCL 20/9

An analysis of plasma transport through the magnetic filter in tandem magnetic multicusp negative hydrogen ion sources was conducted to determine the mechanism of thermal electron diffusion, explain thermal electron cooling, describe the transport of primary electrons through the filter, and model positive ion species transport. The thermal electron flux was shown to exceed its classical value by one to three orders of magnitude. The flux variation with temperature was best described using a Coulomb-like temperature gradient drag term, consistent with diffusion due to ion-sound-like turbulence. Thermal electron energy flux loss was shown to be dominated by inelastic collisions at low values of the particle flux. Consequently, an equation was derived which correctly reproduces the observed variation in the ratio of source to extraction chamber densities as a function of the ratio of source to extraction chamber electron temperatures. The primary electron flux was found to be one order of magnitude higher than the classical collisional rate. Positive ion species transport was modelled assuming ballistic flow. Ion production and loss mechanisms were used in conjunction with transport to calculate extracted positive ion species percentages. Results were found to be in reasonable agreement with experiment. GRA

N92-19532# Technische Univ., Eindhoven (Netherlands).

PLASMA CHEMISTRY OF FLUOROCARBON RF DISCHARGES USED FOR DRY ETCHING Ph.D. Thesis

Marco Haverlag 10 Sep. 1991 143 p Sponsored in part by Netherlands Technology Foundation

(ETN-92-90895) Avail: NTIS HC/MF A07

Investigations on capacitively coupled RF plasma in flurocarbon gases excited at 13.56 MHz are reported. These plasmas are commonly used for many applications where a substrate must be etched, for example in the manufacturing of integrated circuits. Diagnostics to measure the densities of both neutral and charged species in RF plasma of fluorocarbon gases that are widely used for etching of Si and SiO2 and to determine the etching characteristics of those discharges in various circumstances were developed. The experimental results are compared with numerical models of the kinetics of both charged and neutral particles in the plasma. The state of the surface was analyzed in situ, to obtain information on etching mechanisms for Si and SiO2 substrates in fluorocarbon plasma. The study focuses on CF4 plasma. Results on other fluorine containing gases are used as a comparison. ESA

N92-19540 Texas Univ., Austin.

MAGNETOHYDRODYNAMIC STUDIES OF IDEAL AND RESISTIVE TEARING MODES WITH EQUILIBRIUM SHEAR FLOW Ph.D. Thesis

Xiao-Liang Chen 1991 138 p

Avail: Univ. Microfilms Order No. DA9200601

Two magnetohydrodynamic (MHD) instabilities are studied. A simple sufficient condition is given for the linear ideal instability of plane parallel equilibria with antisymmetric shear flow and symmetric or antisymmetric magnetic field. Application of this condition demonstrates the destabilizing effect of the magnetic field on shear flow driven Kelvin-Helmholz instabilities. For the resistive tearing instability, the effect of equilibrium shear flow is systematically studied, using the boundary layer approach. Both the constant-psi tearing mode and the nonconstant-psi tearing mode are analyzed in the presence of flow. It is found that the shear flow has a significant influence on both the external ideal region and the internal resistive region. In the external ideal region, the shear flow can dramatically change the value of the matching quantity delta'. In the internal resistive region, the tearing mode scalings are sensitive to the flow shear at the magnetic null plane. When the flow shear is larger than the magnetic field shear at the magnetic null plane, both tearing modes are stabilized. Also, the transition to ideal instability was traced. Furthermore, the influence of small viscosity on the constant-psi tearing mode in the presence of shear flow is considered. It is found that the influence of viscosity depends upon the parameter, v sub 0'(O)B sub 0'(O), where V sub 0'(O) and B sub 0'(O) denote the flow shear and magnetic field shear at the magnetic null plane, respectively. Viscosity basically tends to suppress the tearing mode. Finally, the nonlinear interaction of two near-marginal tearing modes in the presence of shear flow is studied. To find the time asymptotic states, the resistive MHD equations are reduced to four amplitude equations, using center manifold reduction. These amplitude equations are subject to the constraint of translational symmetry of the physical problem. Bifurcation analysis is employed to find various possible time asymptotic states. Author

N92-19558 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.

THE FLOW OF LOW-TEMPERATURE PLASMA IN A QUADRUPOLE MAGNETIC FIELD [TECHENIE NIZKOTEMPERATURNOI PLAZMY V KVADRUPOLNOM MAGNITNOM POLE]

G. A. Diuzhev and M. A. Zhakov 1990 18 p In RUSSIAN

Copyright Avail: Issuing Activity

This work is devoted to experimental research of the quasistationary flow of low-temperature hydrogen plasma along the neutral line of a quadrupole magnetic field. The spatial distribution of plasma parameters are measured: concentration, potential, temperature, and electrons. It is shown that, as a result of turbulent electrical conductivity and the minor value of the actual magnetic Reynolds number, the inner magnetic field is freely diffused in plasma. The form of magneto-plasma configuration is defined by the axial current exchange induced in the plasma when the plasma flow intersects the strong line of the magnetic field.

Transl. by L.K.H.

N92-19559# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
WIDE-APERTURE GAS ION SOURCES BASED ON PULSE ARC DISCHARGES [SHIROKOAPERTURNYE ISTOCHNIKI GAZOVYKH IONOV NA OSNOVE IMPULSNYKH DUGOVYKH RAZRIADOV]
N. V. Gavrilov and Yu. E. Kreindel 1990 21 p In RUSSIAN
Avail: NTIS HC/MF A03

In this work the principles of movement, in particular, the construction and design of an electrical power supply, are investigated. Also, the characteristics of the sources of powerful broad beams of gaseous ions based on pulse arc discharges with shielded cathode spots, in which the cation and anion parts of the discharge are divided with the goal of an increase in stabilization of the source function, resulting in a decrease in contamination of beams by products of cathode erosion. Transl. by L.K.H.

N92-19588# Applied Microwave Plasma Concepts, Carlsbad, CA.
THE OPTIMIZATION OF PRODUCTION AND CONTROL OF HOT-ELECTRON PLASMAS
R. A. Dandl and G. E. Guest 1 Oct. 1991 53 p
(Contract DE-FG03-87ER-53256)
(DE91-019076; AMPC-031-046) Avail: NTIS HC/MF A04

This report discusses the following topics: the generation rate of ECH triggered runaway electrons; space- and time-resolved measurements using free-free Bremsstrahlung; and wave propagation characteristics in the tokamak. DOE

N92-19692# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Lab. Associado de Plasma.
MAGNETIC DIAGNOSTICS FOR THE PROTO-ETA TOKAMAK
Jose Leonardo Ferreira, Yoshiyuki Aso, Mario Ueda, and Julio Guimaraes Ferreira Jun. 1991 25 p Presented at the US-Brazil Experts' Workshop on Spherical Torus Experiments, Sao Jose dos Campos, Brazil, 1-9 May 1990
(INPE-5256-PRE/1680) Avail: NTIS HC/MF A03

A general view of the magnetic diagnostics that will be used in the proto-Eta tokamak is provided. These diagnostics are useful tools for measuring the currents, electric fields, and magnetic fields involved in the plasma magnetic confinement. The determination of the magnitude of these parameters is essential to the study of plasma magnetohydrodynamic (MHD) equilibrium and instability. The experimental plasma research in this field is especially relevant as there are no experimental data concerning plasma magnetic confinement in small aspect ratio tokamaks. Author

N92-19718# Wisconsin Univ., Madison.
TURBULENT TRANSPORT IN THE MST REVERSED-FIELD PINCH
T. D. Rempel, A. F. Almagri, S. Assadi, D. J. DenHartog, S. A. Hokin, S. C. Prager, J. S. Sarff, W. Shen, K. L. Sidikman, and C. W. Spragins et al Nov. 1991 27 p Presented at the 33rd Annual Division of Plasma Physics/American Physical Society Meeting, Tampa, FL, 4-8 Nov. 1991
(Contract DE-FG02-85ER-53198)
(DE92-005230; DOE/ER-53198/184; CONF-9111127-6) Avail: NTIS HC/MF A03

Measurements of edge turbulence and the associated transport are ongoing in the Madison Symmetric Torus (R = 1.5 m, a = 0.52 m) reversed field pinch using magnetic and electrostatic probes. Magnetic fluctuations are dominated by m = 1 and n approx. = 2R/a tearing modes. Particle losses induced by magnetic field fluctuations have been found to be ambipolar (less than the Hermitian conjugate of J par ellel to the Hermitian conjugate of B sub r greater than/B sub o = 0). Electrostatic fluctuations are broadband and turbulent, with mode widths (delta)m similar to 3 to 7 and (delta)n similar to 70 to 150. Particle, parallel current, and energy transport arising from coherent motion with the fluctuating the Hermitian conjugate of ExB drift has been measured. Particle transport via this channel is comparable to the total particle loss from MST. Energy transport (from less than the Hermitian conjugate of P Herm itian conjugate of E sub phy greater than/B sub o) due to electrostatic fluctuations is relatively small, and parallel current transport (from less than Hermitian conjugate of J parallel to Hermitian conjugate of E sub phi greater than/B sub o) may be small as well. DOE

N92-19834# Stanford Univ., CA. High Temperature Gasdynamics Lab.
FUNDAMENTAL PROCESSES IN PARTIALLY IONIZED PLASMAS Annual Report, 1 Oct. 1990 - 30 Sep. 1991
C. H. Kruger, Matt Gordon, and Christophe Laux Oct. 1991 24 p
(Grant AF-AFOSR-0264-88; AF Proj. 2301)
(AD-A244054; AFOSR-91-0930TR) Avail: NTIS HC/MF A03
CSCL 20/9

Research during this past year has emphasized studies of plasmas properties and associated diagnostics, including nonequilibrium effects in so-called thermal plasmas. The present report discusses first measurements of the radiative source strength of air for temperatures in the range between 5000 and 7500 K. To our knowledge these are the first measurements of this important property in this temperature range. The results are compared with a NASA computer code. Also described is a study of quenching effects on excited states of a nonequilibrium thermal plasma. These and companion measurements show that the common assumption of local thermodynamic equilibrium in plasmas at or about atmospheric pressure can be seriously in error and that as a result the reliability of many temperature measurements in such plasmas should be questioned. GRA

N92-19860# California Univ., Los Angeles. School of Engineering and Applied Science.
PLASMA SURFACE INTERACTION: THEORY AND MODELING
R. W. Conn and F. Najmabadi 1992 14 p
(Contract DE-FG03-86ER-52130)
(DE92-007056; DOE/ER-52130/T2) Avail: NTIS HC/MF A03

This report discusses active edge plasma and impurity control; coupled edge plasma and neutral particle transport; and engineering design of in-vessel components. DOE

N92-19900# Maryland Univ., College Park. Lab. for Plasma Research.
ACCELERATOR RESEARCH STUDIES
1992 101 p
(Contract DE-FG05-91ER-40642)
(DE92-007160; DOE/ER-40642/1) Avail: NTIS HC/MF A06

The Accelerator Research Studies program at the University of Maryland, sponsored by the Department of Energy under grant number DE-FG05-91ER-40642, is currently in the first year of a three-year funding cycle. The program consists of the following three tasks: TASK 1, Study of Transport and Longitudinal Compression of Intense, High-Brightness Beams; TASK 2, Study of Collective Ion Acceleration by Intense Electron Beams and Pseudospark Produced High Brightness Electron Beams; TASK 3, Study of a Gyroklystron High-power Microwave Source for Linear Colliders. In this report we document the progress that has been made during the past year for each of the three tasks. DOE

N92-19948*# Wisconsin Univ., Madison. Dept. of Nuclear Engineering and Engineering Physics.
SPACE CHARGE ENHANCED PLASMA GRADIENT EFFECTS ON SATELLITE ELECTRIC FIELD MEASUREMENTS
Dan Diebold, Noah Hershkowitz, J. DeKock, T. Intrator, and M-K. Hsieh 1991 34 p
(Grant NAG5-1135)
(NASA-CR-187834; NAS 1.26:187834) Avail: NTIS HC/MF A03
CSCL 20I

It has been recognized that plasma gradients can cause error in magnetospheric electric field measurements made by double probes. Space charge enhanced Plasma Gradient Induced Error (PGIE) is discussed in general terms, presenting the results of a laboratory experiment designed to demonstrate this error, and deriving a simple expression that quantifies this error. Experimental conditions were not identical to magnetospheric conditions,

although efforts were made to insure the relevant physics applied to both cases. The experimental data demonstrate some of the possible errors in electric field measurements made by strongly emitting probes due to space charge effects in the presence of plasma gradients. Probe errors in space and laboratory conditions are discussed, as well as experimental error. In the final section, theoretical aspects are examined and an expression is derived for the maximum steady state space charge enhanced PGIE taken by two identical current biased probes. H.A.

N92-19975# General Atomic Co., San Diego, CA.
ERROR FIELD CONSIDERATIONS FOR BPX
R. J. LaHaye Nov. 1991 5 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-005394; GA-A-20579; CONF-910968-64) Avail: NTIS HC/MF A01

Irregularities in the position of poloidal and/or toroidal field coils in tokamaks produce resonant toroidal asymmetries in the vacuum magnetic fields. Otherwise stable tokamak discharges become non-linearly unstable to disruptive locked modes when subjected to low level error fields. Because of the field errors, magnetic islands are produced which would not otherwise occur in tearing mode stable configurations; a concomitant reduction of the total confinement can result. Poloidal and toroidal asymmetries arise in the heat flux to the divertor target. The field errors from perturbed BPX coils are used in a field line tracing code of the BPX equilibrium to study these deleterious effects. Limits on coil irregularities for device design and fabrication are computed along with possible correcting coils for reducing such field errors. DOE

N92-19987# Science Applications International Corp., McLean, VA.
EFFECTS OF ENERGETICAL PARTICLES ON BALLOONING MODES IN HIGH TEMPERATURE TOKAMAKS
K. T. Tsang 22 Jan. 1992 16 p
(Contract DE-FG03-90ER-54108)
(DE92-007280; DOE/ER-54108/T1) Avail: NTIS HC/MF A03

This report describes the work done by Science Applications International Corporation to study the effects of energetic particles on the microstability of a high temperature tokamak. The effects of an energetic population on ballooning modes in a large aspect ratio, shifted circular flux surface tokamak equilibrium are investigated with the newly developed gryokinetic numerical technique. The gryokinetic equations for the background ion and electron, as well as that of the energetic population are solved directly as an initial problem. The energetic particles are modeled with a slow-down distribution in energy. It is found that the ballooning mode stability of the plasma with an energetic species of increasing concentration does not differ much from an increase in the background plasma beta, except for possible energetic particle drift resonances. This result is encouraging to the idea that energetic particles such as alphas may be used to stabilize the ballooning modes in a fusion reactor. DOE

N92-19995# General Atomic Co., San Diego, CA.
TIMING SYSTEM FOR NEUTRAL BEAM INJECTION ON THE D3-D TOKAMAK
G. Bramson Nov. 1991 4 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-005438; GA-A-20640; CONF-910968-56) Avail: NTIS HC/MF A01

Eight neutral beam (NB) long pulse sources mounted on four beamlines are in use on the D3-D tokamak, a magnetic confinement fusion experiment at General Atomics. The main purpose of NB injection is to heat the bulk plasma with high energy injected neutral particles which undergo ionizing collisions with plasma ions and electrons. NB injection is also used as a diagnostic tool for charge exchange recombination spectrometry to determine ion temperatures and rotation velocities and for neutral particle exchange spectrometry to determine spatial distributions of beam ions. This paper describes recent modifications to the D3-D central timing system hardware and software to allow more flexible and complex timing waveforms than previously available to control NB injection. In the past, for each plasma discharge, the start time and the pulse duration for each NB source could be set. The new NB timing system allows the experimental session leader to specify more than one pulse for each NB source to make efficient use of multiple physics experiments in a single discharge. Also, pulse trains with programmable duty cycles can be independently specified for each NB source to make NB injection a more useful diagnostic tool. Experimental results using features of the new NB timing system are presented. DOE

N92-19996# General Atomic Co., San Diego, CA.
THE DESIGN AND FABRICATION OF A TOROIDALLY CONTINUOUS CRYOCONDENSATION PUMP FOR THE D3-D ADVANCED DIVERTOR
J. P. Smith, C. B. Baxi, E. Reis, M. J. Schaffer, K. M. Schaubel, and M. M. Menon (Oak Ridge National Lab., TN.) Nov. 1991 3 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-005441; GA-A-20672; CONF-910968-62) Avail: NTIS HC/MF A01

A cryocondensation pump will be installed in the baffle chamber of the DIII-D tokamak in the spring of 1992. The design is complete and fabrication of this pump is in progress. The purpose of the pump is to study plasma density control by pumping the divertor. The pump is toroidally continuous, approximately 10 m long, in the lower outer corner of the vacuum vessel interior. It consists of a 1 m(exp 2) liquid helium cooled surface surrounded by a liquid nitrogen cooled shield to limit the heat load on the helium cooled surface. The stainless steel liquid nitrogen shell has a copper coating on it to enhance thermal conductivity, but the coating is broken to keep the toroidal electrical resistance high. The liquid nitrogen cooled surface is surrounded by a radiation/particle shield to prevent energetic particles from impacting and releasing condensed water molecules. The whole pump is supported off the water cooled vacuum vessel wall. Key design considerations were: how to accommodate the temperature differences between the various components, developing low heat leak paths for the various supports, and maintaining electrical insulation in a low pressure environment in the presence of induced voltage spikes. A single point ground for the system was used to limit disruption induced currents and the resulting electro-mechanical forces on the pump. A testing program was used to develop coating techniques to enhance heat transfer and emissivity of the various surfaces. Fabrication tests were done to determine the best method of attaching the liquid nitrogen flow tubes to their shield surfaces. A prototype sector of the pump was built to verify fabrication and assembly techniques. DOE

N92-19997# General Atomic Co., San Diego, CA.
THE USE OF A VAX CLUSTER FOR THE D3-D DATA ACQUISITION SYSTEM
B. B. McHarg, Jr. Nov. 1991 4 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-005443; GA-A-20584; CONF-910968-59) Avail: NTIS HC/MF A01

The DIII-D tokamak is a large fusion energy research experiment funded by the Department of Energy. The experiment currently collects nearly 40 Mbytes of data from each shot of the experiment. In the past, most of this data was acquired through the MODCOMP Classic data acquisition computers and then transferred to a DEC VAX computer system for permanent archiving and storage. A much smaller amount of data was acquired from a few MicroVAX based data acquisition systems. In the last two years, MicroVAX based systems have become the standard means for adding new diagnostic data and account for half the total data. There are now 17 VAX systems of various types at the

DIII-D facility. As more diagnostics and data are added, it takes increasing amounts of time to merge the data into the central shot file. The system management of so many systems has become increasingly time consuming as well. To improve the efficiency of the overall data acquisition system, a mixed interconnect VAX cluster has been formed consisting of 16 VAX computers. In the cluster, the software protocol for passing data around the cluster is much more efficient than using DECnet. The cluster has also greatly simplified the procedure of backing up disks. Another big improvement is the use of a VAX console system which ties all the console ports of the computers into one central computer system which then manages the entire cluster. DOE

N92-19998# General Atomic Co., San Diego, CA.
EIGHT CHANNEL - 16 BIT, BIDIRECTIONAL ANALOG TO DIGITAL MONITORING AND CONTROL SYSTEM
J. C. Allen, R. W. Callis, W. P. Cary, T. E. Harris, and A. Nerem Nov. 1991 3 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-005445; GA-A-20604; CONF-910968-61) Avail: NTIS HC/MF A01

The DIII-D tokamak facility is currently upgrading its electron cyclotron resonance heating (ECH) system. The new system is based on 110 GHz gyrotrons developed by Varian. As part of this upgrade, the superconducting magnet power supplies were required to be remotely controlled and monitored accurately. The 110 GHz gyrotron superconducting magnet has eight coils that are energized by current regulating power supplies. An analog to digital (A/D) system was designed to allow remote coil current monitoring and power supply programming. The A/D system is an eight channel multiplexed, 16 bit, bidirectional, fiber optically linked, analog to digital telemetry system. Design concerns and trade-offs will be discussed as will the results of in system use. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-19072# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
GROWTH, CHARACTERIZATION, AND DEVICE DEVELOPMENT IN MONOCRYSTALLINE DIAMOND FILMS Annual Letter Report, 1 Jan. - 31 Dec. 1991
Robert F. Davis Dec. 1991 101 p
(Contract N00014-90-J-1604)
(AD-A244000) Avail: NTIS HC/MF A06 CSCL 09/1

The nucleation of diamond grains on an unscratched silicon wafer is enhanced by four order of magnitude relative to scratched substrates by using negative bias enhanced microwave plasma CVD in a 2 percent methane/hydrogen plasma for an initial period. In vacuo surface analysis has revealed that the actual nucleation occurs on the amorphous C coating present on the thin SiC layer which forms as the product of the initial reaction with the Si surface. It is believed that the C forms critical clusters which are favorable for diamond nucleation. Similar enhancement was observed together with the occurrence of textured diamond films in the use of bias pretreatment of cubic Beta SiC substrates. Approximately 50 percent of the initial diamond nuclei were aligned with the SiC substrate. In contrast, the use of the biasing pretreatment for one hour on polycrystalline substrates resulted in only about 7 percent coverage with diamond particles. Numerous techniques have been used to analyze the nucleation and growth phenomena, especially micro Raman and scanning tunneling microscopy. The latter technique has shown that the morphology of doped and undoped diamond nuclei are similar, as well as the fact that significant concentrations of vacancy related defects are present. In device related-studies, UV-photoemission studies have shown that TiC occurs at the Ti-diamond (100) interface after a 400 C anneal. The Schottky barrier height from this metal on p-type diamond was determined to be 1.0 eV. Indications of negative electron affinity (NEA) was observed and attributed to emission of electrons that are quasi-thermalized to the bottom of the conduction band. A disordered surface removes the NEA. The microwave performance of p-type (beta-doped) diamond MESFET's at 10 GHz has been further investigated. Elevated temperatures may be necessary to obtain sufficient free charge densities in the conducting channel but this will result in degraded device performance. Each of these sections are self-contained including the pertinent references. GRA

N92-19079# Parke Mathematical Labs., Inc., Carlisle, MA.
GROWTH AND CHARACTERIZATION OF III-V EPITAXIAL FILMS Final Report, Mar. 1988 - Nov. 1990
A. Tripathi and J. Adamski Nov. 1991 122 p
(Contract F19628-88-C-0061)
(AD-A244071; RL-TR-91-297) Avail: NTIS HC/MF A06 CSCL 20/2

Investigations were conducted on the growth of epitaxial layers using an Organo Metallic Chemical Vapor Deposition technique of selected III-V materials which are potentially useful for photonics and microwave devices. RL/ERX's MOCVD machine was leak checked for safety. The whole gas handling plumbing system has been leak checked and the problems were reported to the manufacturer, CVD Equipment Corporation of Dear Park, NY. CVD Equipment Corporation is making an effort to correct these problems and also supply the part according to our redesign specifications. One of the main emphasis during this contract period was understanding the operating procedure and writing an operating manual for this MOCVD machine. To study the dynamic fluid flow in the vertical reactor of this MOCVD machine, an experimental apparatus was designed, tested, and put together. This study gave very important information on the turbulent gas flow patterns in this vertical reactor. The turbulent flow affects the epitaxial growth adversely. This study will also help in redesigning a vertical reactor so that the turbulent gas flow can be eliminated. GRA

N92-19090# Colorado Univ., Colorado Springs.
MAGNETIC STRUCTURES AND EXCITATIONS IN THIN FILMS AND MULTILAYERS Final Report, Jun. 1988 - Sep. 1991
R. E. Camley and D. L. Mills 22 Nov. 1991 10 p
(Contract DAAL03-88-K-0061)
(AD-A244422; ARO-25374.14-PH) Avail: NTIS HC/MF A02 CSCL 20/3

The main topics include: (1) gigantic magnetoresistance in magnetic multilayers; (2) properties of ultra-thin magnetic films; (3) infrared properties of magnetic materials and doped semiconductors; and (4) phase transitions and the tailoring of magnetic properties in magnetic multilayers. GRA

N92-19095# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
LOW TEMPERATURE PHOTOLUMINESCENCE STUDY OF SILICON-GERMANIUM ALLOY SUPERLATTICES M.S. Thesis
Maxwell M. Chi Dec. 1991 121 p
(AD-A243893; AFIT/GEP/ENP/91D-1) Avail: NTIS HC/MF A06 CSCL 20/2

Low temperature photoluminescence studies were performed on nine silicon germanium alloy superlattice samples. The luminescence spectra showed sharp peaks in the 0.95 to 1.05 eV energy range, and a broad band located 0.05 to 0.12 eV below the alloy bandgap. The sharp peaks were identified as transitions associated with impurity bound excitons. The linewidth was about 10 times that in pure silicon; in addition, the peaks shifted to lower energy as the sample temperature was raised from 1.4 to 15 K. These features were attributed to effects of random distribution of atoms in the alloy. The broad band shifted to lower energy as the temperature was raised and also narrowed considerably in bandwidth. This broad luminescence was attributed to recombination of excitons confined in potential wells created by local fluctuations in the alloy composition. GRA

N92-19104# Northwestern Univ., Evanston, IL. Dept. of Materials Science.
EFFECT OF INTERSTITIALS ON THE TRAPPING OF HYDROGEN IN IRON-SINGLE CRYSTALS Final Report, 21 Jan. 1985 - 20 Jul. 1991
James T. Weaver Nov. 1991 41 p
(Contract DAAG29-85-K-0032)
(AD-A244223; ARO-21545.14-MS) Avail: NTIS HC/MF A03 CSCL 20/2

A non destructive method of determining the densities of edge and screw dislocations was developed. Using it, thermal elimination of dislocation was shown to be a binary and two stage process for both (1) cold-rolled, and (2) metallographically polished specimens. The process involves the glide of dislocation dipoles rather than vacancy migration and climb. A method of extracting kinetic information from isochronal runs was developed and tested with isothermal runs. The strong effect of surface dislocations on reducing the diffusion of hydrogen and deuterium in iron single crystals was demonstrated. Positron lifetime results were then used to determine dislocation densities and the results were verified using transmission electron microscopy (TEM) and etch pit techniques on the same crystals. A few confirmatory experiments were made on annealed and on twisted iron whiskers. Internal friction measurements (to show the effects of trapped hydrogen) were also made on annealed, cold-worked, and charged high-purity single-crystal iron specimens. GRA

N92-19106*# Alabama Univ., Huntsville. Center for Microgravity and Materials Research.
PROCESS MODELLING FOR MATERIALS PREPARATION EXPERIMENTS Semiannual Progress Report No. 5, 1 Aug. 1991 - 31 Jan. 1992
Franz Rosenberger and J. Iwan D. Alexander 31 Jan. 1992 38 p
(Grant NAG8-790)
(NASA-CR-189904; NAS 1.26:189904) Avail: NTIS HC/MF A03 CSCL 20B

The development is examined of mathematical tools and measurement of transport properties necessary for high fidelity modeling of crystal growth from the melt and solution, in particular for the Bridgman-Stockbarger growth of mercury cadmium telluride (MCT) and the solution growth of triglycine sulphate (TGS). The tasks include development of a spectral code for moving boundary problems, kinematic viscosity measurements on liquid MCT at temperatures close to the melting point, and diffusivity measurements on concentrated and supersaturated TGS solutions. A detailed description is given of the work performed for these tasks, together with a summary of the resulting publications and presentations. Author

N92-19128# Oak Ridge National Lab., TN.
SUPERCONDUCTING PROPERTIES AND MICROSTRUCTURE OF YBa2Cu3O(7-DELTA) / PrBa2Cu3O(7-DELTA) SUPERLATTICES
D. H. Lowndes, D. P. Norton, X. Y. Zheng, and Shen Zhu (Tennessee Univ., Knoxville.) Oct. 1991 9 p Presented at the 4th International Symposium on Superconductivity, Tokyo (Japan), 14-17 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-003512; CONF-911096-3) Avail: NTIS HC/MF A02

Epitaxial YBa2Cu3O(7-(delta) / PrBa2Cu3O(7-delta) (YBCO/PBCO) superlattices are tools for systematic, fundamental studies of high temperature superconductivity. The variation of (Tc) in YBCO/PBCO superlattices can be understood as arising from changes in the interlayer phase coupling between YBCO layers that are highly 2-D when they are very thin (approx. 1 to 2 c-axis unit cells) and completely isolated from each other. Single cell thick YBCO layers, containing isolated pairs of CuO2 planes, are found to be superconducting at (Tc) approx. 20 K, in a PBCO matrix. The resistance in the superconducting transition region scales with temperature as expected for the (flux flow) resistance produced by thermally generated 2-D vortices, or for a 2-D array of superconducting weak links. Relative to both thin film and single crystal HTSc specimens, the thin superconducting layers in YBCO/PBCO superlattices exhibit a greatly expanded temperature range over which characteristic 2-D dissipation can be observed, as a consequence of the enhanced anisotropy and reduced dimensionality of the YBCO layers. Scanning tunneling microscope studies reveal that YBCO films and YBCO/PBCO superlattices grow unit cell-by-unit cell by a terraced-island growth mechanism. On miscut, near-(001) substrates the terraces are epitaxially aligned with the substrate crystal lattice and spiral growth structures (screw dislocation mediated growth) are not seen. These observations explain the steps or 'kinks' that are seen in cross section Z-contrast TEM images of YBCO/PBCO superlattices. The kinks may correspond physically to regions where the supercurrent must tunnel along the c-axis, and thus may be weak link barriers. DOE

N92-19274# Rochester Univ., NY.
ULTRAFAST OPTICAL STUDIES OF SURFACE REACTION PROCESSES AT SEMICONDUCTOR INTERFACES
R. J. D. Miller Nov. 1991 6 p
(Contract DE-FG02-91ER-14185)
(DE92-004019; DOE/ER-14185/1) Avail: NTIS HC/MF A02

Electron transfer processes at interfaces constitute a large and important class of surface reactions. In addition, the rectifying properties of semiconductor interfaces makes these systems one of the simplest and most efficient systems for converting and storing optical energy. However, the primary events of interfacial electron or hole carrier transfer and competing non-radiative (energy loss) channels are not well understood at surfaces. This research has explored the use of two novel optical techniques, Surface Space Charge Electro-optic Sampling and Surface Restricted Transient Grating Spectroscopy, to obtain the time evolution of the surface spatial distribution of photogenerated charge carriers and the photocarrier population dynamics at semiconductor interfaces, respectively. These studies have shown that carriers arrive at GaAs (100) surfaces on the hundred femtosecond time scale and subsequently undergo interfacial charge transfer on the picosecond time scale to appropriate acceptors. These dynamics are competitive with carrier thermalization processes and support the concept that it may be possible to significantly improve energy conversion efficiencies by minimizing energy loss through carrier thermalization. The exact dynamics still need to be resolved. A new laser system has been developed in the first year of funding that is capable of 10 femtosecond time resolution. This system will have sufficient time resolution to completely resolve both the electron and hole carrier non-radiative relaxation processes as well as the interfacial carrier charge transfer dynamics. DOE

N92-19338# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
POLYCRYSTALLINE THIN FILM MATERIALS AND DEVICES
B. N. Baron, R. W. Birkmire, J. E. Phillips, W. N. Shafarman, S. S. Hegedus, and B. E. McCandless (Delaware Univ., Newark.) Nov. 1991 65 p Prepared in cooperation with Delaware Univ., Newark, DE
(Contract DE-AC02-83CH-10093)
(DE92-001171; NREL/TP-214-4502) Avail: NTIS HC/MF A04

Results and conclusions of Phase 1 of a multi-year research program on polycrystalline thin film solar cells are presented. The research comprised investigation of the relationships among processing, materials properties and device performance of both CuInSe2 and CdTe solar cells. The kinetics of the formation of CuInSe2 by selenization with hydrogen selenide was investigated and a CuInSe2/Cds solar cell was fabricated. An alternative process involving the reaction of deposited copper-indium-selenium layers was used to obtain single phase CuInSe2 films and a cell efficiency of 7 percent. Detailed investigations of the open circuit voltage of CuInSe2 solar cells showed that a simple Shockley-Read-Hall recombination mechanism can not account for the limitations in open circuit voltage. Examination of the influence of CuInSe2 thickness on cell performance indicated that the back contact behavior has a significant effect when the CuInSe2 is

less than 1 micron thick. CdTe/CdS solar cells with efficiencies approaching 10 percent can be repeatedly fabricated using physical vapor deposition and serial post deposition processing. The absence of moisture during post deposition was found to be critical. Improvements in short circuit current of CdTe solar cells to levels approaching 25 mA/cm(exp 2) are achievable by making the CdS window layer thinner. Further reductions in the CdS window layer thickness are presently limited by interdiffusion between the CdS and the CdTe. CdTe/CdS cells stored without protection from the atmosphere were found to degrade. The degradation was attributed to the metal contact. CdTe cells with ZnTe:Cu contacts to the CdTe were found to be more stable than cells with metal contacts. Analysis of current-voltage and spectral response of CdTe/CdS cells indicates the cell operates as a p-n heterojunction with the diode current dominated by SRH recombination in the junction region of the CdTe. DOE

N92-19368# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

SILICON CARBIDE THIN FILM DEPOSITION BY REACTIVE ION-BEAM SPUTTERING M.S. Thesis

Larry G. Sills Dec. 1991 69 p

(AD-A243970; AFIT/GEP/ENP/91D-7) Avail: NTIS HC/MF A04 CSCL 20/12

In this study, hydrogenated amorphous silicon carbide thin films were deposited by reactive ion-beam sputtering under varying conditions to determine whether a film's optical properties can be controlled, focusing on refractive index. Using a Kaufman type ion source to sputter a pure silicon target, three distinct series of films were grown. The first series varied the mixture of methane and argon used in the ion-beam, holding all other parameters constant. For the second series the gas mix was fixed, and only the beam energy (beam voltage) was varied. The final series also varied beam energy, but was grown with a graphite shield next to the target to reduce metal contamination sputtered from chamber surfaces. Results show the index of refraction increased monotonically with beam energy up to a beam voltage of 1300 volts. Both the second and third series of films followed this trend, but analysis of differences in atomic composition between two series revealed opposite trends for how the silicon to carbon content ratio and refractive index were related. More precise control of the gas flow, and sputtering from only the intended (silicon) targets would have reduced experimental errors. GRA

N92-19372# Research Triangle Inst., Research Triangle Park, NC.

SEMICONDUCTOR DIAMOND TECHNOLOGY Annual Report, 1 Jan. - 31 Dec. 1991

R. J. Markunas, R. A. Rudder, J. B. Posthill, and R. E. Thomas 31 Dec. 1991 107 p

(Contract N00014-86-C-0460)

(AD-A243986; RTI-83U-3629-A; RTI/3629/91-A) Avail: NTIS HC/MF A06 CSCL 20/12

The development of techniques to enhance diamond heteronucleation without abrasive ex situ surface treatment now permits researchers to study diamond heteronucleation (epitaxy) at growth temperatures far below the thermal desorptions of hydrogen (H) and oxygen (O). At these temperatures, surface chemistry on the nucleating surface will be controlled by chemical exchange and abstraction reactions. This final report highlights the important results achieved during 1991 in diamond production and in diamond surface chemistry. Of particular interest are O and H interactions on diamond (100) surfaces and the development of water-based processes exclusive of molecular hydrogen for high quality low temperature diamond growth. The role of oxygen or hydroxyl is becoming increasing illucidated as surface chemistry studies show the propersity for O to terminate and stabilize 1x1 surfaces and as water-based growth processes permit diamond stabilization and growth at lower and lower temperatures. GRA

N92-19398*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

CHEMICAL STABILITY OF HIGH-TEMPERATURE SUPERCONDUCTORS

Narottam P. Bansal Feb. 1992 23 p

(NASA-TM-105391; E-6781; NAS 1.15:105391) Avail: NTIS HC/MF A03 CSCL 20L

A review of the available studies on the chemical stability of the high temperature superconductors (HTS) in various environments was made. The La(1.8)Ba(0.2)CuO4 HTS is unstable in the presence of H2O, CO2, and CO. The YBa2Cu3O(7-x) superconductor is highly susceptible to degradation in different environments, especially water. The La(2-x)Ba(x)CuO4 and Bi-Sr-Ca-Cu-O HTS are relatively less reactive than the YBa2Cu3O(7-x). Processing of YBa2Cu3O(7-x) HTS in purified oxygen, rather than in air, using high purity noncarbon containing starting materials is recommended. Exposure of this HTS to the ambient atmosphere should also be avoided at all stages during processing and storage. Devices and components made out of these oxide superconductors would have to be protected with an impermeable coating of a polymer, glass, or metal to avoid deterioration during use. Author

N92-19458# General Atomic Co., San Diego, CA.

HIGH-TEMPERATURE CERAMIC SUPERCONDUCTORS Final Annual Report No. 3, 1 Oct. 1990 - 30 Sep. 1991

K. S. Mazdiyasni, F. C. Montogomery, K. C. Chen, S. S. Pak, and D. M. Duggan 15 Dec. 1991 99 p

(Contract N00014-88-C-0714)

(AD-A243960; GA-A20796) Avail: NTIS HC/MF A05 CSCL 20/3

The principle goals of this program were (1) to demonstrate fabrication of high-temperature ceramic superconductors via a sol gel method that can operate at or above 90K with appropriate current density, J sub c, in forms useful for application in resonant cavities, magnets, motors, detectors, computers, and other devices; and (2) to fabricate and demonstrate selected components made of these materials, Including microwave cavities and magnetic shield. The approach is to develop the sol gel technology processing of high-temperature ceramic superconductors to make sol gel a viable process for fabricating high T sub c (90 K) superconductors in forms useful for applications. The nature of sol-gel processing makes it inherently amenable to fabricating the thin films and fibers that are needed for many applications. In addition, the relatively low temperature characteristics of sol-gel processing make it advantageous for many applications in which the superconducting materials must be applied to heat sensitive substrates. GRA

N92-19476# International Centre for Theoretical Physics, Trieste (Italy).

MC SIMULATIONS OF HIGHLY ANISOTROPIC 2D HARD DUMBBELLS: APERIODIC PHASE BETWEEN FLUID AND DENSE SOLID

K. W. Wojciechowski Mar. 1991 46 p

(DE92-603747; IC-91/38) Avail: NTIS HC/MF A03

Monte Carlo simulations of a two-dimensional hard homonuclear dumbbell system with a high anisotropy parameter $d^* = 0.924$ were performed for three different thermodynamic states: fluid; aperiodic molecular solid, whose molecular arrangements can be represented by certain decorations of the Kagome lattice; and high-density solid, whose molecular structure corresponds to dense packing of the dumbbells. The latter structure was exemplified in this study by a herring-bone crystal. Explicit calculations of the free energies of the different states together with the analysis of the melting region show that the aperiodic solid structures form a thermodynamically stable phase between the fluid and the dense solid. The equation of state, structural properties, and the locations of the phase transitions are reported. The role of the degeneracy entropy in the aperiodic phase is discussed. DOE

N92-19504# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
THE EFFECTIVENESS AND STABILITY OF IMPURITY/DEFECT INTERACTIONS AND THEIR IMPACT ON MINORITY CARRIER LIFETIME
G. A. Rozgonyi, F. Shimura, A. Buczkowski, and T. Q. Zhon (North Carolina State Univ., Raleigh.) Dec. 1991 58 p
(Contract DE-AC02-83CH-10093)
(DE92-001172; NREL/TP-214-4503) Avail: NTIS HC/MF A04

This report covers the investigation and understanding of electrical activity of 'clean' and metallic impurity decorated defects. A heterostructure containing a controlled number of deliberately introduced misfit dislocations is used as a model system to simulate a variety of defect/impurity interactions in photovoltaic materials. In addition, a noncontact laser/microwave deep-level transient spectroscopy technique is applied to characterize the minority carrier lifetime and determine the energy levels of defects. DOE

N92-19514# Brown Univ., Providence, RI.
ELEMENTARY EXCITATIONS, OPTICAL, AND TRANSPORT PROPERTIES OF ARTIFICIALLY STRUCTURED MATERIALS Final Report
John J. Quinn Oct. 1991 9 p
(Contract DAAL03-88-K-0026)
(AD-A244096; ARO-25167.16-PH) Avail: NTIS HC/MF A02
CSCL 20/5

A number of problems involving the electronic properties of artificially structured semiconductors have been studied. The study of the ground state and the elementary excitations of a double quantum well system revealed the existence of a novel 'excitonic charge density wave state.' Donor states, both singly and doubly occupied, in a modulation doped quantum well were investigated. Magnetic polaron effects in a variety of artificial structures were studied. GRA

N92-19556 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
SUPERLATTICES ON HOT ELECTRONS IN MULTI-VALLEY SEMICONDUCTORS [SVERKHRESHETKI NA GORIACHIKH ELECTRONAKH V MNOGODOLINNYKH POLUPROVODNIKAKH]
P. M. Tomchuk and N. G. Sytilina 1989 34 p In RUSSIAN
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A theory is developed for superlattices on free carriers in a many valleyed semiconductor in the field of high frequency coherent light beams in local and nonlocal approximations at weak and strong heating of carriers without the constant heating electric field. The concrete situation in n-Ge was examined and the results are presented for a numerical calculation of the modulation of the electron temperature electron concentration and a self-consistent field which arises as a result of the breakdown of quasineutral conditions, as well as the field dependences of electron temperatures. Transl. by L.K.H.

N92-19564 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
CHANGES IN THE KINETICS OF LAYER GROWTH DURING LIQUID-PHASE EPITAXY IN A GAMMA-RADIATION FIELD [IZMENENIE KINETIKI ROSTA SLOER PRI ZHIDKOFAZNOI EPITAKSII V POLE GAMMA-OBLUCHENIIA]
E. M. Kuritsyn 1990 17 p In RUSSIAN
Copyright Avail: Issuing Activity

It is shown that application of irradiation by gamma-particles during the growth of layers from the liquid phase results in a significant change in the processes of mass transfer of growth layer matter from a change in the solution-melt to the growth surface. The homogeneous crystallization decreases in the change of the solution-melt to a convective admixture of atoms of the substance layer and metal solvent. The observed effects can explain the diffusion of atoms of the substance layer in the exchange of solution-melt under the influence of gamma-irradiation. The change taking place in the process of mass transfer results in the unique characteristics found in the epitaxial layer. Transl. by L.K.H.

N92-19575# California Inst. of Tech., Pasadena.
GRAIN BOUNDARY AND INTERFACE KINETICS DURING ION IRRADIATION
H. A. Atwater 1991 40 p
(Contract DE-FG03-89ER-45395)
(DE92-005589; DOE/ER-45395/T1) Avail: NTIS HC/MF A03

Proposed here is renewed support of a research program focused on interface motion and phase transformation during ion irradiation, with emphasis on elemental semiconductors. Broadly speaking, the aims of this program are to explore defect kinetics in amorphous and crystalline semiconductors, and to relate defect dynamics to interface motion and phase transformations. Over the last three years, we initiated a program under DOE support to explore crystallization and amorphization of elemental semiconductors under irradiation. This research has enabled new insights about the nature of defects in amorphous semiconductors and about microstructural evolution in the early stages of crystallization. In addition, we have demonstrated almost arbitrary control over the relative rates of crystal nucleation and crystal growth in silicon. As a result, the impinged grain microstructure of thin (100 nm) polycrystalline films crystallized under irradiation can be controlled with grain sizes ranging from a few nanometers to several micrometers, which may have interesting technological implications. DOE

N92-19592# Brookhaven National Lab., Upton, NY.
THE ac LOSSES IN YBa2Cu3O7 AND Bi2Sr2Ca2Ci3O10 SUPERCONDUCTORS AT POWER FREQUENCIES
J. Orehotsky, K. M. Reilly, M. Suenaga, T. Hikata, M. Ueyama, and K. Sato (Sumitomo Electric Industries Ltd., Osaka, Japan) 1991 4 p Presented at the 4th International Symposium on Superconductivity, Tokyo, Japan, 14-17 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-004990; BNL-46823; CONF-911096-5) Avail: NTIS HC/MF A01

Ac losses of sintered and melt-textured YBa2Cu3O7 bars and powder-in-a-tube processed Bi2Sr2Ca2Cu3O10 tapes were measured at 4.2, 65, 70 and 77 K and at 15 to 180 Hz. In general, the results are well described by the critical state model for the ac losses. However, the losses for the Bi2Sr2Ca2Cu3O10 tapes at 4.2 K exhibited significant contributions from the eddy currents in the Ag sheath. DOE

N92-19599 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
A THEORY OF THERMOMAGNETIC PHENOMENA IN LOW-SYMMETRY CRYSTALS [TEORIIA TERMOMAGNITNYKH IAVTENII V KRISTALLAKH NIZKOI SIMMETRII]
P. N. Gorlei, A. I. Skitsko, P. M. Tomchuk, and V. A. Shenderovskii 1990 30 p In RUSSIAN
Copyright Avail: Issuing Activity

Using the approximation method to solve the kinetic Boltzman equation, a theory is constructed on the thermomagnetic phenomena in low-symmetry crystals in the presence of a small temperature gradient and an unquantized magnetic field which is arbitrary with respect to size. For the thermoelectric and thermomagnetic tensor components, general analytic expressions are derived in a single ellipsoidal mass coordinate system which can be utilized through analysis of the transfer phenomenon in semiconductors, metals, and semimetals. In the case of P-type tellurium, the coefficients of the random Nerista-Ettingsgauzen effect, the thermoelectromagnetic force, and Lawrence number are studied. Transl. by L.K.H.

N92-19613# Pacific Northwest Lab., Richland, WA.
SEMICONDUCTOR SURFACE AND INTERFACE DYNAMICS FROM TIGHT-BINDING MOLECULAR DYNAMICS SIMULATIONS
G. K. Schenter and J. P. LaFemina Nov. 1991 29 p Presented at the 38th National Symposium of the American Vacuum Society,

Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006488; PNL-SA-19579; CONF-911132-16) Avail: NTIS HC/MF A03

Tight-binding molecular dynamics simulations have been performed to compute the bulk, (110) surface, and (110)-p(1 x 1)Sb(1ML) interfacial atomic vibrational spectra for GaAs and InP. The same tight-binding total energy model which successfully described the static surface and interfacial atomic and electronic structure for these systems is utilized in the molecular dynamics simulations. The results for the bulk vibrational energies are in semi-quantitative agreement with experimental results, displaying approximately the same level of variance as other model computations. Moreover, these simulations are used to examine the effects of anharmonicity in the system by investigating the temperature dependence of the vibrational spectra. The (110) surface vibrational energies are in quantitative agreement with the scattering data, and a comparison of the results for GaAs(110) and InP(110) supports the existance of a surface vibrational mode which is characteristic of the relaxed (110) surface, and whose energy is similar for each zincblende (110) surface. Lastly, the computed vibrational energies for the 3-5(110)-p(1 x 1)-Sb(1ML) interface are in semi-quantitative agreement with Raman scattering data and illustrate the effects of the overlayer binding on the surface vibrational spectrum. DOE

N92-19678# Helsinki Univ. of Technology, Espoo (Finland). Physic Lab.
POINT DEFECT STRUCTURES IN GALLIUM ARSENIDE STUDIED BY POSITRON SPECTROSCOPIES Ph.D. Thesis
Kimmo Saarinen Helsinki, Finland Finnish Academy of Technology 1991 40 p Sponsored by Academy of Finland
(Acta-Polytec-Scand-Ph-175; ISBN-951-666-330-3; ISSN-0355-2721; ETN-92-91020) Avail: NTIS HC/MF A03

Positron spectroscopies were used to examine the point defect structure of gallium arsenide. Experiments to investigate the properties of native defects in as-grown GaAs were performed. The defect production during electron irradiation, hydrogen implantation and plastic deformation of GaAs was studied by positron techniques. New information is obtained especially on the properties of vacancy defects. In as-grown GaAs, the ionization levels of arsenic vacancies are determined. In semi-insulation GaAs, the metastable state of the EL2 defect is shown to contain a monovacancy. The introduction of vacancies and antisite defects to the gallium sublattice is observed in electron irradiation of GaAs. In deformed GaAs, the simultaneous formation of vacancies, antisites and vacancy complexes is detected. The depth distributions of vacancies are determined after hydrogen implantation in semi-insulating GaAs, and the recovery of the implantation damage during isochronal annealing is investigated. ESA

N92-19733# Los Alamos National Lab., NM.
THE BEHAVIOR OF ZrC(1-x) AND U(y)Zr(1-y)C(1-x) IN FLOWING HYDROGEN AT VERY HIGH TEMPERATURES
E. Storms Jan. 1992 56 p
(Contract W-7405-eng-36)
(DE92-006525; LA-12043-MS) Avail: NTIS HC/MF A04

The phase diagrams, thermochemical information, and transport properties of ZrC(1-x) and U(y)Zr(1-y)C(1-x) have been assembled and evaluated. Predictions have been made concerning the general behavior of these alloys in flowing hydrogen. Various tests have been evaluated to show that general predictions are valid to at least 3000 K and possibly up to the melting point. Available tests show that reaction between the carbide and hydrogen is very far from equilibrium. Several new tests are proposed that would be useful in providing further support for the model and make possible an accurate prediction of hydrogen corrosion and vaporization in nuclear propulsion reactors of various designs. Extrapolations using the model show that when U(y)Zr(1-y)C(1-x) is used as the fuel, vaporization at the hottest surface region is the most important life-limiting factor before melting. DOE

N92-19751# Polish Academy of Sciences, Warsaw. Inst. Podstawowych Problemow Techniki.
THEORY OF AGGREGATION AND COAGULATION 2
Praca Zbiorowa 1990 196 p In ENGLISH and POLISH Conference held in Warsaw, Poland, 9-10 Jun. 1989
(IFTR-26/1990; ISSN-0208-5658) Avail: NTIS HC/MF A09

Some papers are presented from the conference. Some representative titles include the following: Kinetics of nucleation and glass formation; On the kinetics of growth of single clusters and Ostwald ripening under the influence of electric field; Effects of impingement on the rotational diffusion coefficient of rigid rods; An influence of various fields on diffusion limited aggregation process; and Void formation and microfracture of strained metals. For individual titles, see N92-19752 through N92-19760.

N92-19752# Bulgarian Academy of Sciences, Sofia. Inst. of Physical Chemistry.
KINETICS OF NUCLEATION AND GLASS FORMATION
Ivan Gutzov *In* Polish Academy of Sciences, Theory of Aggregation and Coagulation 2 1990 p 7-8 (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

Results are summarized on the general, nonsteady state description of the kinetics of nucleation. A number of developments are described including the effect of active foreign substrates (crystallization cores), of surfactants, of a thermal nuclei, etc., on the transient kinetics of nucleation. The influence of nonsteady state nucleation on the kinetics of crystallization process is studied and Ostwald's rule of stages is explained in terms of the same transient theory of nucleation. It is shown how the main kinetic parameter of the nucleation process, the nonsteady state time lag, can be calculated in different cases of phase transformation and how it is influenced both by the nature of the newly formed phase and self diffusion coefficient of the initial phase. Experimental results are given on the kinetics of nucleation in a number of simple glass forming substances, showing the nonsteady state character of this process in glass forming melts. The kinetic stability of an undercooled melt is derived by calculating the cooling rate, at which no detectable crystallization can be observed. Author

N92-19753# Technical Univ. of Rzeszow (Poland). Dept. of Chemistry.
GRAPH-LIKE MODELS OF POLYMER GELATION
Henryk Galina *In* Polish Academy of Sciences, Theory of Aggregation and Coagulation 2 1990 p 9-30 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

Polymer gelation (in crosslinking polymerization, vulcanization, or in other aggregation processors) has been extensively analyzed by using mostly graph-like models. The models are either statistical or kinetic. All these models produce the same size distribution of aggregates for the so called random tree like systems where Flory's principle of equal and conversion independent reactivity of functional groups is obeyed and intermolecular links are neglected. There are many attempts to modify the random tree like model in order to incorporate the two important features of real polymerization systems: substitution effects and intermolecular cyclization. It is shown on simple examples that cyclization plays a much more important role than substitution effects and that the influence of the two features on, e.g., conversion at gelation, cancels each other to some extent. The reasons for differences between statistical and kinetics models in dealing with substitution effects are also discussed. It is shown that the sample space and probability function for the two models are different. The models used for aggregation are compared with two random graph evolution models. Author

N92-19754# Technical Univ. of Lodz (Poland). Inst. of Man-Made Fibers.
DIFFUSION AND AGGREGATION IN WET SPINNING OF VISCOSE FIBERS **c25**
Zdzislaw Choinski *In* Polish Academy of Sciences, Theory of

Aggregation and Coagulation 2 1990 p 31-40 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

When wet spinning viscose fibers in a coagulation bath take place, diffusion of the parts of the bath into viscose jets and neutralization of the bath change the chemical composition of the polymer. In viscose, jets causes separation into liquid phases and solidification of gel fibers. The study was on effects of the concentration of sulfuric acid and zinc sulfate in the coagulation bath in various temperatures on the rate of solidification of viscose, the course of the spinning process and physico-mechanical properties of the resulting fibers. The studies were performed on a tire cord viscose. In all cases studied, solidification was accompanied by formation of large 'finger like' pores. Fibers formed in various coagulation baths exhibited different swelling behavior. Stability of the spinning process markedly increased with concentration of sulfuric acid, while deformability of gel fibers and tenacity of drawn fibers increased with reduction of acid concentration and with increase of zinc sulfate content in the coagulation bath. The degree of crystallinity of drawn and stabilized fibers markedly increases when acid concentration is reduced.
Author

N92-19755# Wilhelm-Pieck-Univ., Rostock (German, D.R.). Sektion Physik.
ON THE KINETICS OF GROWTH OF SINGLE CLUSTERS AND OSTWALD RIPENING UNDER THE INFLUENCE OF ELECTRIC FIELDS
Juern Schmelzer and Heiko Tietze *In* Polish Academy of Sciences, Theory of Aggregation and Coagulation 2 1990 p 41-62 (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

Due to the large surface to volume ratio, dispersions show a general tendency to separate into different bulk phases. Particularly in micellar solutions, thermodynamic factors exist that prevent unlimited growth and result in a time independent, relatively monodisperse distribution of a large number of micelles. Given here is a kinetic description of this process, which represents a modification of the theory of Ostwald ripening in elastic media, developed in cooperation with I. Gutzov (Sofia) in recent years.
Author

N92-19756# Polish Academy of Sciences, Warsaw. Inst. of Fundamental Technological Research.
EFFECTS OF MECHANICAL CONSTRAINTS ON ORIENTATION DISTRIBUTIONS OF POLYETHYLENE CRYSTALLITES DURING MELTING
Pawel Sajkiewicz *In its* Theory of Aggregation and Coagulation 2 1990 p 63-98 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

A further attempt was made to experimentally verify the nucleation theory and its prediction concerning the dependence of the melting temperature on the orientation of crystallites. Changes of orientation distributions of (100) and (200) planes during melting of drawn ultrahigh molecular weight polyethylene were investigated. The samples were prepared according to the procedure of Smith and Lemstra. Melting of these samples was accomplished by a stepwise increase of temperature in a specially designed x-ray diffraction camera. Constant length, freely shrinking, and constant load regimes were investigated. It was confirmed that changes of orientation are dependent on the mechanical conditions applied to the sample. The results indicate that in the case of strained molecules in all applied regimes of mechanical conditions, there is a region of temperatures at which melting is accompanied by a narrowing of crystal orientation distribution. The narrowing of crystal orientation during melting in shrinking regimes presumably confirmed the mechanism of selective melting theoretically predicted by Ziabicki. Author

N92-19757# Polish Academy of Sciences, Warsaw. Inst. of Fundamental Technological Research.
EFFECT OF IMPINGEMENT ON THE ROTATIONAL DIFFUSION COEFFICIENT OF RIGID RODS
Andrzej Ziabicki *In its* Theory of Aggregation and Coagulation 2 1990 p 99-108 (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

Suspension (solutions) of rigid, rodlike molecules form, in the range of higher concentrations, liquid-crystalline (nematic) structures. These structures are controlled by flow field, intermolecular interactions, and interaction with external fields (magnetic and electrostatic). A nonlinear theory describing behavior of flowing, concentrated solutions of rigid rods with dipole interactions (described by a mean-field, Meier-Saupe model) and interactions with external fields is presented. Effects of flow, external fields, and concentration were analyzed and discussed.
Author

N92-19758# Silesian Technical Univ., Gliwice (Poland). Dept. of Physical Chemistry Fundamentals.
AN INFLUENCE OF VARIOUS FIELDS ON DIFFUSION LIMITED AGGREGATION PROCESS
Zbigniew J. Grzywna and Adam Gadomski *In* Polish Academy of Sciences, Theory of Aggregation and Coagulation 2 1990 p 109-124 (For primary document see N92-19751 10-76)
(Contract CPBP-02.11)
Avail: NTIS HC/MF A09

Diffusion limited aggregation (DLA) process on a square lattice was simulated . The Eden cluster-producing algorithm (in which a small test particle is diffusing around the cluster and selecting a perimeter site by hitting it during a diffusion process) was effectively used. It was shown that such a rather simple algorithm enables to simulate a broad variety of diffusion limited aggregation, mostly by changing appropriately the rules of simulation involved. By means of such modifications three types of so called DLA clusters were formed (in fact, in this way a whole class of DLA structures can be obtained): (1) pure (or typical) DLA clusters; (2) DLA clusters with attracting interface (or attracting perimeter sites); and (3) DLA clusters formed by random walk with superimposed drift. The number of perimeter sites, their average distance from the origin as well as the fluctuations of that distance were investigated as a function of the number of cluster particles. An attempt was made to determine the number of cluster particles from which the aforementioned quantities are 'well established', i.e., the stationary state in the aggregation process may be reached. The so called Hausdorff-Besicovitch dimensions of the above mentioned DLA structures were obtained from the adequately chosen rules have a form of scaling laws.
Author

N92-19759# Polish Academy of Sciences, Warsaw. Inst. of Fundamental Technological Research.
DIFFUSION OF SINGLE ELEMENTS AND STERIC CONSTRAINTS IN KINETIC THEORY OF NUCLEATION AND CRYSTALLIZATION
Leszek Jarecki *In its* Theory of Aggregation and Coagulation 2 1990 p 125-164 (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

The translational and rotational diffusion equation is solved for long-range diffusion effects in the kinetic theory of nucleation and crystallization. An analytical formula for effective rate constants is proposed. Boundary conditions, adequate for reversible reaction of cluster growth, and accounting for steric constraints of the reaction, are used. Uniaxial single elements involved in the process are considered. Substantial depression of concentration of single elements at the cluster boundary is predicted, and it is controlled by chemical rate constants, translational and rotational diffusion of single elements, supercooling, and steric constraints. The effective rate constants are derived as controlled by the reduced chemical rate constant of single elements, and the tolerance angle of steric constraints. The rate reduction factor, which is responsible for the effects of long-range diffusion at steric constraints present, is defined.
Author

N92-19760# Polish Academy of Sciences, Warsaw. Inst. of Fundamental Technological Research.
VOID FORMATION AND MICROFRACTURE OF STRAINED METALS **c26**
Jerzy Krzeminski *In its* Theory of Aggregation and Coagulation 2 1990 p 165-188 In POLISH; ENGLISH summary (For primary document see N92-19751 10-76)
Avail: NTIS HC/MF A09

A theory of vacancy-microvoid formation in uniaxially strained metals is presented. The continuum coupled nucleation theory has been applied and extended by using a modified Ziabicki approach for the coupling of both homogeneous and heterogeneous mechanisms; the effect of strain on the free energy of formation of vacancy clusters was also taken into account. Three models of clusters are considered: spherical, double-lens, and spherical trihedron. Conventional microfracture criterion for origination of a critical cluster (microcrack nucleus) is proposed from which the corresponding critical strain can be found.
Author

N92-19786# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PHOTOLUMINESCENCE SPECTROSCOPY OF MBE GROWN GALLIUM ANTIMONIDE M.S. Thesis
John A. Dorian Dec. 1991 61 p
(AD-A243911; AFIT/GEP/ENP/91D-4) Avail: NTIS HC/MF A04 CSCL 20/5

Experimental data are presented for the energy levels of the native acceptor and bound exciton emissions of GaSb grown by MBE and studied with low temperature photoluminescence (PL) spectroscopy. The undoped GaSb emissions showed a donor-acceptor pair transition with an observed emission peak at 776 meV, a peak at 716 meV usually associated with the ionization level of the acceptor, and bound exciton transitions in the energy range from 796 to 804 meV. Other unidentified peaks were observed at about 805 meV. Temperature and power dependence studies of the acceptor peak confirmed donor-acceptor pair (DAP) behavior. A GaSb sample grown with a high antimony background pressure had emissions which were broad as compared to those emissions of a sample grown with a lower V:III flux. The full width at half maximum was 45 meV and was due to multiple peaks. A temperature dependence study aided in the identification of three separation emissions, assigned as follows: 772 meV, due to a DAP, and 760 and 751 meV due to a deep acceptor level associated with a free to bound transition. GRA

N92-19788# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
PSEUDOMORPHIC SEMICONDUCTING HETEROSTRUCTURES FROM COMBINATIONS OF AlN, GaN AND SELECTED SiC POLYTYPES: THEORETICAL ADVANCEMENT AND ITS COORDINATION WITH EXPERIMENTAL STUDIES OF NUCLEATION, GROWTH, CHARACTERIZATION, AND DEVICE DEVELOPMENT Annual Letter Report, 1 Jan. - 31 Dec. 1991
Robert F. Davis Dec. 1991 45 p
(Contract N00014-90-J-1427)
(AD-A244001) Avail: NTIS HC/MF A03 CSCL 09/1

Cubic solid solutions of AlN and SiC have been epitaxially deposited for the first time in this film form on Beta-SiC films grown on Si(100) using gas-source molecular beam epitaxy (GSMBE). Specific studies of the deposition of unintentionally-doped beta-SiC on Si(100) and Al-doped beta-SiC on alpha (6H)-SiC(0001) have also been achieved via GSMBE. Cross-sectional TEM confirmed the epitaxial growth of the three types of films. A low concentration of double positioning boundaries was observed in the material deposited on alpha(6H)-SiC. The initial stages of nucleation and thin film growth of AlN and GaN on sapphire and alpha(6H)-SiC single crystals were also investigated. No significant changes in the substrate surface chemistry was observed for growth on sapphire; however, Si4N4 was observed on the SiC surface as a result of ion bombardment prior to deposition. The growth of GaN on sapphire followed a Stranski-Krastanov growth mode, while on SiC, it appeared to be three-dimensional. By contrast, AlN grew on both substrates initially by a layer-by-layer mode. Ultraviolet radiation during deposition did not produce any significant changes in the nucleation and growth of these materials. GRA

N92-19790# North Carolina State Univ., Raleigh.
ATOMIC LAYER EPITAXY GROUP 4 MATERIALS: SURFACE PROCESSES, THIN FILMS, DEVICES, AND THEIR CHARACTERIZATION Annual Report
Robert F. Davis, Salah Bedair, Nadia El-Masry, and Jeffrey T. Glass Dec. 1991 30 p
(Contract N00014-91-J-1416)
(AD-A244005) Avail: NTIS HC/MF A03 CSCL 07/2

Research concerned with the atomic layer epitaxy (ALE) of silicon carbide (SiC), diamond (C) and cerium dioxide (CeO2) has been carried out within this reporting period. Equipment for the deposition of each of these materials, as well as experimental procedures for the conduct of the studies are in various stages of design, development, and employment. The initial design of the SiC ALE deposition equipment has been tested with the growth of Si on Si(100) using dichlorosilane or disilane coupled with the use of atomic hydrogen produced via cracking of molecular hydrogen over a hot tungsten filament. Microbeam analysis revealed epitaxial single crystal films were obtained above a sample temperature of 400 C. The equipment for the deposition of C from C2H4 has also been installed. To achieve the ALE of C, the atomic arrangement during the initial nucleation step has received primary consideration. To achieve two-dimensional growth, organic interlayers will be deposited on the substrate followed by diamond growth. Initial results using linolenic acid as the interlayer and subsequent diamond deposition are encouraging. A system for epitaxial growth of CeO2 has been designed and is under construction. Operation in early 1992 is anticipated. GRA

N92-19827# Argonne National Lab., IL.
SYNTHESIS OF C-ORIENTED YbBa2Cu3O(7-DELTA) FILMS ON SINGLE AND POLYCRYSTALLINE SUBSTRATES BY OXIDATION OF LIQUID ALLOYS
J. S. Luo, N. Merchant, V. A. Maroni, D. M. Gruen, B. S. Tani, K. H. Sandhage, and C. A. Craven Nov. 1991 7 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract W-31-109-eng-38)
(DE92-005189; ANL/CP-74977; CONF-911202-20) Avail: NTIS HC/MF A02

Textured superconducting films of YbBa2Cu3O(7-delta) supported on single and polycrystalline substrates were prepared by oxidation of a liquid precursor alloy. The substrates were coated by dipping them into a molten alloy (YbBa2Cu3, m.p. approx. 870 C), withdrawing them from the melt, then oxidizing the adhering liquid alloy layer to the corresponding oxide phase, i.e., YbBa2Cu3O(7-delta). Samples prepared in this way exhibited a superconducting transition at approx. 80 K following annealing in pure OP2 at 500 C. With SrTiO3 (100) and MgO (100) substrates, evidence was seen for the epitaxial growth of YbBa2Cu3O(7-delta) crystals having their c-axis parallel to the (100) direction of the substrate. For polycrystalline MgO, x ray diffraction and microstructural examination showed that the high-Tc crystallites in the films were also oriented with their c-axis perpendicular to the substrate surface, but the a and b axes directions were randomly oriented rather than epitaxial. DOE

N92-19849# Brookhaven National Lab., Upton, NY.
SOFT X RAY RESONANT MAGNETIC SCATTERING STUDY OF THIN FILMS AND MULTILAYERS
C. C. Kao, E. D. Johnson, J. B. Hastings, D. P. Siddons, and C. Vettier (European Synchrotron Radiation Facility, Grenoble, France) 1991 9p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26p Jul. 1991
(Contract DE-AC02-76CH-00016)
(DE92-002072; BNL-46650; CONF-9107115-54) Avail: NTIS HC/MF A02

A brief review of using soft x-ray resonant magnetic scattering in the study of magnetic thin films and multilayers is given. Results from recent studies of thin Fe films and Fe/Gd multilayers are used as examples to demonstrate the information that can be obtained and the unique features of this technique. Comparison is also made with related techniques: magneto-optical Kerr effect, Faraday effect, and magnetic circular dichroism. DOE

N92-19863# Argonne National Lab., IL.
GRAIN BOUNDARY MICROSTRUCTURE AND TRANSPORT CRITICAL CURRENT DENSITY IN YBa2 Cu3 O(SUB x)
Donglu Shi, Yufei Gao, A. C. Biondi, J. G. Chen, K. L. Merkle, and K. C. Goretta Sep. 1991 10 p Presented at the 5th Annual Conference on Superconductivity and Applications, Buffalo, NY, 24-26 Sep. 1991
(Contract W-31-109-eng-38; NSF DMR-88-09854)
(DE92-004133; ANL/CP-73450; CONF-9109102-3) Avail: NTIS HC/MF A02

It is proposed that the transport critical current J(sub c) density for high-(Tc) thin films, bicrystals, and bulk ceramics is determined by magnetic field penetration into the grain boundaries; the grain orientation may not in all cases be an important factor. The parameter (lambda sub L)/(lambda sub J) (exp 2) can characterize the strength of the grain boundary coupling, which depends mainly on the crystal coherence and the structure of the boundary. DOE

N92-19895# Sandia National Labs., Albuquerque, NM.
SYNTHESES AND PROPERTIES OF (KAPPA)-PHASE ORGANIC SUPERCONDUCTORS
H. H. Wang, K. D. Carlson, U. Geiser, A. M. Kini, A. J. Schultz, J. M. Williams, U. Welp, K. E. Darula, V. M. Hitsman, and M. W. Lathrop et al 1991 11 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contracts DE-AC04-76DP-00789; W-31-109-eng-38)
(DE92-004353; SAND-91-2826C; CONF-911202-8) Avail: NTIS HC/MF A03

The syntheses and physical properties of (kappa)-(ET)-2Cu(N(CN)2)X (X=Br and Cl) are summarized. The (kappa)-(ET)2Cu(N(CN)2)Br salt is the highest T(sub c) radical-cation based ambient pressure organic superconductor (T(sub c) = 11.6K),and the (kappa)-(ET)2Cu(N(CN)2)Cl salt becomes a superconductor at even higher T(sub c) under 0.3 kbar hydrostatic pressure (T(sub c) = 12.8 K). The similarities and differences between (kappa)-(ET)2Cu(N(CN)2)Br and (kappa)-(ET)2Cu(NCS)2 (T(sub c) = 10.4 K) are presented. The X-ray structures at 127 K reveal that the the S...S contacts shorten between ET dimers in the former compound while the S...S contacts shorten within dimers in the latter. The difference in their ESR linewidth behavior is also explained in terms of the structural differences. A semiconducting compound, (ET)Cu(N(CN)2)2, isolated during (kappa)-(ET)2Cu(N(CN)2)Cl synthesis is also reported. The ESR measurements of the (kappa)-(ET)-2Cu(N(CN)2)Cl salt indicate that the phase transition near 40 K is similar to the spin density wave transition in (TMTSF)2SbF6. A new class of organic superconductors, (kappa)-(ET)2Cu2(CN)3 and (kappa)-(ET)2Cu2(CN)3-delta(Br)(delta), is reported with T (sub c)'s of 2.8 K (1:5 kbar) and 2.6 K (1 kbar), respectively. DOE

N92-19897# Oak Ridge National Lab., TN.
HIGH-ENERGY ION IMPLANTATION OF MATERIALS
J. M. Williams Nov. 1991 23 p Presented at the Workshop on Surface Processing, Dearborn, MI, 10-12 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005157; CONF-911281-1) Avail: NTIS HC/MF A03

High-energy ion implantation is an extremely flexible type of surface treatment technique, in that it offers the possibility of treating almost any type of target material or product with ions of almost any chemical species, or combinations of chemical species. In addition, ion implantations can be combined with variations in temperature during or after ion implantation. As a result, the possibility of approaching a wide variety of surface-related materials science problems exists with ion implantation. This paper will outline factors pertinent to application of high-energy ion implantation to surface engineering problems. These factors include fundamental advantages and limitations, economic considerations, present and future equipment, and aspects of materials science. DOE

N92-19905# European Space Agency, Paris (France).
LONG PERIOD SUPERSTRUCTURES IN Pt3V AND Cu3Pd: TOWARDS A QUANTITATIVE DESCRIPTION
Jerome Planes (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Jun. 1991 248 p Transl. into FRENCH of Structures a Longue Periode dans Pt3V et Cu3Pd: Vers une Description Quantitative (Paris, France, ONERA) 1 Jun. 1990 195 p Original language document was announced as N91-11587
(ESA-TT-1233; ONERA-NT-1990-2; ETN-92-90742) Avail: NTIS HC/MF A11

One dimensional long period ordered superstructures in Pt3V and Cu3Pd alloys are studied experimentally with the aim of providing a quantitative description of the periodic antiphase boundary modulation on which these structures are built, and also of understanding the nature of the transitions between these phases. A real space approach is described through a digital analysis of high resolution electron microscope images which provide the occupation probability of atomic columns by one type of atom. In this way, an antiphase boundary profile depending on concentration and temperature is defined. The complementary approach in reciprocal space is tackled through in situ x-ray diffraction experiments. Assuming the smoothed square wave function of the modulation to be a particular analytic function, the measured intensity ratios of low order harmonics gives the value of the boundary width: it increases with temperature. The whole set of results is discussed in relation to statistical mechanical models, particularly the ANNNI model, which is at present the most fruitful in yielding qualitative features in long period superstructures. ESA

N92-19936# Pacific Northwest Lab., Richland, WA.
ATOMIC STRUCTURE OF THE SnO2 (110) SURFACE
T. J. Godin and J. P. LaFemina Dec. 1991 5 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC06-76RL-01830)
(DE92-006512; PNL-SA-19742; CONF-911202-37) Avail: NTIS HC/MF A01

Using a tight-binding, total-energy model, we examine atomic relaxations of the ideal stoichiometric and reduced tin oxide (11) surfaces. In both cases we find a nearly bond-length conserving rumple of the top layer, and a smaller counter-relaxation of the second layer. These calculations show no evidence of surface states in the band gap for either surface. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-19203# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
MODEL TO DESCRIBE MELT RATES BY HEAT CONDUCTION Final Report, period ending Apr. 1990
Paul S. Grasso Aug. 1991 18 p
(DA Proj. 1L1-61102-A-71-A)
(AD-A244193; CRDEC-TR-297) Avail: NTIS HC/MF A03
CSCL 20/13

This report presents a model developed to predict conductive heat transfer through thick solids where melting occurs. Sample calculations will illustrate the use of this model, and an estimating

function for the range of applicability will be discussed. Predicting melt rates and thermal profiles in solids is of fundamental interest to the flame and incendiary program. Such analysis allows one to integrate the combustion characteristics of an incendiary with the target heat transfer parameters to predict weapon effectiveness against the target and to optimize the fill composition. This modeling process minimizes the experimental and chemical formulation effort that, in turn, reduces research and development costs. As an initial effort, a conductive heat transfer model that predicts solid internal temperatures and melt rates was developed. Model simplicity was of significant importance, because it provided a closed analytical solution that allowed for a functional description of the heat transfer process and a basis on which to expand this effort. Future model verification will also require analysis of the test system, which was designed to accommodate controlled test conditions rather than actual target challenges. GRA

N92-19402# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
DEFINITION AND EVOLUTION OF STATES IN RELATIVISTIC CLASSICAL AND QUANTUM MECHANICS
L. P. Horwitz Sep. 1991 28 p
(PB92-115526; IHES/P/91/57) Avail: NTIS HC/MF A03
CSCL 20C

Some of the problems associated with the construction of a manifestly covariant relativistic quantum theory are discussed. A resolution of the problem is given in terms of the off mass shell classical and quantum mechanics of Stueckelberg, Horwitz, and Piron. The theory contains many questions of interpretation, reaching deeply into the notions of time, localizability, and causality. A proper generalization of the Maxwell theory of electromagnetic interaction, required for the well-posed formulation of dynamical problems of systems with electromagnetic interaction, is discussed, and some of the significance of recently found (classical) chaotic behavior is shown. Many results of a technical nature were achieved in the framework; some of these are reviewed, but the concentration is on a discussion of the basic ideas and foundations of the theory. Author

N92-19684# Kozponti Fizikai Kutato Intezet, Budapest (Hungary).
APPLICATION OF THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES FOR THE SIMULTANEOUS DIFFUSION OF BORON AND ARSENIC AND POINT DEFECTS IN SILICON MATERIAL
Dao Khac An (Institute of Physics, Hanoi, Vietnam) 1990 49 p
(PB91-223875; KFKI-1990-28/E; ISSN-0368-5330) Avail: NTIS HC/MF A03 CSCL 20M

The simultaneous diffusion of two dopants (boron and arsenic) and point defects (vacancy and interstitial) in silicon were described both by the phenomenological Fick's diffusion theory and thermodynamics of irreversible processes theory. The simultaneous diffusion fluxes of dopants and point defects, as well as phenomenological coefficients and cross-coefficients, in complex systems were derived and discussed. GRA

N92-19817# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
QUANTUM GROUP SYMMETRIES OF CONFORMAL FIELD THEORIES
F. Falceto and K. Gawedzki Sep. 1991 18 p Presented at the 20th International Conference on Differential Geometric Methods in Theoretical Physics, New York, NY, 3-7 Jun. 1991 Prepared in cooperation with Rutgers - The State Univ., New Brunswick, NJ
(PB92-115542; IHES/P/91/59) Avail: NTIS HC/MF A03
CSCL 20C

The appearance of quantum groups in conformal field theories is traced back to the Poisson-Lie symmetries of the classical chiral theory. A geometric quantization of the classical theory deforms the Poisson-Lie symmetries to the quantum group ones. This elucidates the fundamental role of chiral symmetries that quantum groups play in conformal models. As a byproduct, one obtains a more geometric approach to the representation theory of quantum groups. GRA

N92-19859# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
ON CAUSALITY PRINCIPLE IN RELATIVISTIC GRAVITATION THEORY
Yu. V. Chugreev 1990 10 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE92-608074; IFVE-OTF-90-143) Avail: NTIS HC/MF A02

The causality principle in relativistic gravitation theory is discussed. The examples of gravitational fields satisfying this principle and unphysical fields which do not satisfy it are presented. DOE

N92-19869# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
GENERAL RELATIVITY AND EXPERIMENT: A BRIEF REVIEW
T. Damour Oct. 1991 10 p
(PB92-125012; IHES/P/91/69) Avail: NTIS HC/MF A02
CSCL 03A

The review concentrates on existing experimental tests of general relativity. Several solar system experiments are presently in development (GPS, POINTS, etc.), and a significant part of the efforts in the field of experimental gravitation is devoted to the construction of detectors of gravitational radiation (notably large interferometric detectors, GEO, LIGO, VIRGO, etc.). Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-19028# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A HYPERTEXT VERSION OF THE CERTIFIED PROFESSIONAL CONTRACTS MANAGER CANDIDATE'S WORKBOOK M.S. Thesis
Dean P. McLain Sep. 1991 84 p
(AD-A244269; AFIT/GCM/LSP/91S-8) Avail: NTIS HC/MF A05
CSCL 05/1

The purpose of this study was to develop and test a hypertext version of the Certified Professional Contracts Manager Candidate's Workbook and Supplements. A literature review was conducted on two distinct subject areas. The first area includes a review of the findings of six commissions on professionalism of acquisition personnel, initiatives of the Office of Personnel Management, the Defense Acquisition Workforce Improvement Act, and the National Contract Management Association. The discussion of professionalism in contracting establishes the relevance of products like the hypertext workbook completed as a result of this research. The second area is a review of the history of hypertext, applicable definitions, application schemes, and system design. Through a development effort that followed five objectives, a complete hypertext workbook was designed and tested. The results of the questionnaire answered by ten graduate students revealed that the hypertext workbook was easy to install, learn and use. GRA

N92-19081# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
IDENTIFYING FEDERAL CONTRACTING POLICY CHANGES TO IMPROVE GOVERNMENT ACQUISITION OF COMMERCIAL SPACE-LAUNCH CAPACITY M.S. Thesis
Bryan S. Moon Sep. 1991 163 p
(AD-A244076; AFIT/GCM/LSP/91S-9) Avail: NTIS HC/MF A08 CSCL 05/4

The study dealt with expressed congressional intent to promote the commercial space-launch industry and defense management emphasis on government use of commercial contracting methods for the purchase of commercial products. The research problem was to determine what contracting policy changes implementing commercial-like practices would benefit the commercial space-launch industry and Federal space-launch acquisition. Commercial-like contracting practices include removal of statutory and regulatory barriers to contracting with the government. To accomplish this, the most significant contractual barriers experienced by the industry in doing business with the government were identified. The study hypothesized possible relationships among barriers, acquisition cost variables, industry well-being variables, and commercial-like variables. Ten of eleven firms responded to the interview questionnaire, including the three industry leaders. Quantitative analysis revealed very strong associations for the hypothesized relationships. Qualitative analysis supported the quantitative results. Barriers were associated with higher costs and hurting the industry, while commercial-like contracting by the government was associated with lower costs and promoting the industry. GRA

N92-19109# Joint Research Centre of the European Communities, Ispra (Italy).
[ACTIVITIES REPORT OF THE JOINT RESEARCH CENTER OF THE COMMISSION OF THE EUROPEAN COMMUNITIES] Annual Report, 1989
1990 110 p
(EUR-12954-EN; ETN-92-90838) Copyright Avail: NTIS HC/MF A06

The Joint Research Center (JRC) is a European scientific and technical research center. Major achievements of the JRC are outlined as it executes its four main functions: specific research programs on a multiannual basis; support activities at the request of other commission services; work under contract for third parties; and exploratory research to open up new avenues and to maintain scientific excellence. JCR enhances scientific cohesion within the Community by participating in EUREKA projects and by grouping scientific resources under schemes as associated laboratories in well specified scientific topics. Utilization of large installations and test facilities and the construction of new installations are considered. Human and financial resources are also considered. The following are annexed: publications, Euro courses, application of results, exhibitions and fairs; a financial statement of accounts; addresses of the board of governors; and an organization chart. ESA

N92-19120*# National Aeronautics and Space Administration, Washington, DC.
VISION 21: THE NASA STRATEGIC PLAN
Jan. 1992 48 p
(NASA-TM-107805; NAS 1.15:107805) Avail: NTIS HC/MF A03 CSCL 05A

The NASA Strategic Plan, Vision 21, is a living roadmap to the future to guide the men and women of the NASA team as they ensure U.S. leadership in space exploration and aeronautics research. This multiyear plan consists of a set of programs and activities that will retain our leadership in space science and the exploration of the solar system; help rebuild our nation's technology base and strengthen our leadership in aviation and other key industries; encourage commercial applications of space technology; use the unique perspective of space to better understand our home planet; provide the U.S. and its partners with a permanent space based research facility; expand on the legacy of Apollo and initiate precursor activities to establish a lunar base; and allow us a journey into tomorrow, journey to another planet (Mars), and beyond. Author

N92-19220# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
DEFINING CONTRACT TERMS M.S. Thesis
Stephanie Shelley Sep. 1991 118 p
(AD-A243835; AFIT/GCM/LSP/91S-13) Avail: NTIS HC/MF A06 CSCL 05/2

This thesis researched the meanings of 25 contract terms. First the literature was reviewed for existing definitions, then a proposed definition was written for each term, based on the literature search. These definitions were then mailed out to selected contracting professionals for their review. The definitions were then revised based on the comments received. GRA

N92-19243# Naval Ocean Systems Center, San Diego, CA.
STATISTICAL DECISION MAKING WITH UNCERTAIN AND CONFLICTING DATA Final Report, Oct. 1990 - Aug. 1991
R. A. Dillard Sep. 1991 51 p
(AD-A243853; NOSC/TR-1451) Avail: NTIS HC/MF A04 CSCL 12/3

Automated decision making techniques are studied for use in situations where incoming tactical reports are frequently inaccurate or incorrect and where information about probability models is limited. The first problem addressed is to find a decision method for deciding among a set of hypothesis (H sub i) based on a set of evidence (E sub j), given data quality factors (W sub j) and numerical probability judgements such as (P(H sub i/E sub j) or (P(E sub j/H sub i)). Four candidate decision methods are compared: the linear opinion pool, the logarithmic opinion pool, Dempster's rule, and a fuzzy-logic algorithm. Comparisons include the MYCIN certainty-factor calculus for the two-hypothesis examples. The decision methods give similar results, but none is fully satisfactory. At least one should perform adequately if selected carefully for the decision problem, but an effort should be made to find a fully suitable method. Several statistical techniques are investigated for measuring the relevance of evidence to a decision problem and for identifying suspicious or conflicting evidence. An approach to implementing the decision process in a knowledge based system is outlined. The problem of eliciting and aggregating numerical probability judgements is also discussed. GRA

N92-19439# Joint Research Centre of the European Communities, Ispra (Italy).
[ACTIVITIES REPORT OF THE JOINT RESEARCH CENTER OF THE COMMISSION OF THE EUROPEAN COMMUNITIES] Annual Report, 1990
1991 103 p
(EUR-13572-EN; ETN-92-90837) Copyright Avail: NTIS HC/MF A06

The Joint Research Center (JRC) is a European scientific and technical research center. Major achievements of the JRC are outlined as it executes its four main functions: specific research programs on a multiannual basis; support activities at the request of other commission services; work under contract for third parties; and exploratory research to open up new avenues and to maintain scientific excellence. JRC enhances scientific cohesion within the community by participating in EUREKA projects and by grouping scientific resources under schemes as associated laboratories in well specified scientific topics. Human and financial resources are considered. The following are annexed: financial accounts; publications, Euro courses, applications of results; exhibitions and fairs, press, and public relations; board of governors and organization chart; and a glossary of acronyms and abbreviations. ESA

N92-19602# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
ENERGY-BASED APPROACH FOR TASK SCHEDULING UNDER TIME AND RESOURCE CONSTRAINTS Ph.D. Thesis -

Toulouse Univ.
Pierre Lopez 1991 147 p In FRENCH; ENGLISH summary
(LAAS-91337; ETN-92-90949) Avail: NTIS HC/MF A07

Independent tasks under time and resource constraints are scheduled. The method and techniques developed refer to the so called 'constraints-based analysis' in scheduling problems. This analysis aims to characterize admissible schedules in order to provide the decision maker with a set of coherent actions in relation to constraints. The analysis is described as an inference process between a basis of rules and a basis of temporal and sequential facts representing the characteristics of admissible schedules. Previous work allowed the realization of the MASCOT software written in PROLOG. A new approach is presented and a concept of energy is introduced by combining time and resources. Also a time resource interval is introduced so that simultaneous representation of temporal and resource characteristics is possible. The consumer intervals (tasks) and the supplier intervals are distinguished. The deduction used in MASCOT was improved by taking into account the interactions between consumer and supplier intervals. New rules of deduction were written and integrated in MASCOT yielding a new MASCOT2 software. A deduction process based only on the energy concept was elaborated and implemented in PROLOG. It involves remarkable times, breakpoints of energy curves associated with the tasks. The bound-potential graph is used as a model: it allows constraints between intervals to be represented. It constitutes a support to an inference process by propagation of numerical constraints. ESA

N92-19798# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
THE USE OF ALTERNATIVE DISPUTE RESOLUTION TECHNIQUES TO RESOLVE GOVERNMENT CONTRACT DISPUTES: A CASE STUDY M.S. Thesis
John N. Kraus, Jr. Sep. 1991 91 p
(AD-A244206; AFIT/GCM/LSL/91S-6) Avail: NTIS HC/MF A05 CSCL 05/1

The purpose of this study was to examine the decision-making processes involved in using Alternative Dispute Resolution (ADR) Techniques in lieu of litigation to resolve government contract disputes. With the enactment of Public Law 101-552, The Administrative Dispute Resolution Act, federal agencies are encouraged to use mediation, arbitration, and other ADR techniques for the prompt and informal resolution of disputes. Although the use of ADR in the private sector is increasing dramatically, use within the government has been minimal, in part, because of a general lack of knowledge about ADR and its practical application. An initial step towards broadening the knowledge base is to document the decision-making processes in cases where ADR has been used. A descriptive case study method was used to evaluate six completed ADR cases and one as yet unresolved case. Each was examined to determine: why the parties used ADR instead of litigation; how the specific ADR techniques were chosen; and how and on what basis the neutral advisor was chosen. Based on the data generated from each case, patterns and trends across the cases were identified. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-19063# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DESIGN AND APPLICATION OF AN OBJECT ORIENTED GRAPHICAL DATABASE MANAGEMENT SYSTEM FOR SYNTHETIC ENVIRONMENTS M.S. Thesis
John A. Brunderman Dec. 1991 120 p
(AD-A243788; AFIT/GA/ENG/91D-01) Avail: NTIS HC/MF A06 CSCL 12/7

The Air Force Institute of Technology (AFIT) is investigating the use of synthetic environments for military applications under the sponsorship of Rome Laboratories (RL). Areas under investigation include mission planning, battle management and flight simulation. The work reported in this thesis focuses on the object-oriented design and implementation of the Graphical Database Management System (GDMS) used to support research in these areas. GDMS provides the data structures, file format and algorithms to manage and render hierarchical, three-dimensional, polygonal models. Flexibility and adaptability were key factors in its design. A secondary objective of this research was to demonstrate the functionality of GDMS through the development of a characteristic application. This led to the design and implementation of a Database Generation System (DBGen) for the construction and manipulation of synthetic environments. DBGen allows a user to orient, scale, move, delete and add multiresolution objects to synthetic environment interactively. It also provides a real time fly-through capability for immediate feedback on the dynamic response of the database. The development of the Graphical Database Management System was successful. The design and implementation of four major synthetic environment applications based on GDMS tested its flexibility, while the rapid incorporation of a number of special effects algorithms in final stages of the development cycle demonstrated its adaptability. GRA

N92-19287# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SURFACE AND DEFECTS EXCITATIONS IN COVALENTLY BONDED SOLIDS Annual Report, 1 Oct. 1990 - 30 Sep. 1991
J. D. Joannopoulos 20 Dec. 1991 5 p
(Contract N00014-90-J-1370)
(AD-A244129) Avail: NTIS HC/MF A01 CSCL 05/2

The following papers are listed: Optimized pseudopotentials; Ab-initio materials science and engineering using the molecular dynamics methods for total energy pseudopotential calculations; Oxygen complexes in Si; The enchanting properties of oxygen atoms in silicon; The electronic structure of oxygen in silicon as revealed by volume visualization of ab-initio calculations; Photonic bound states in periodic dielectric materials; Precise and efficient ab-initio molecular dynamics; and Donor and acceptor modes in photonic band structures. Additionally, the publication status of other papers, books, and patents is listed. GRA

N92-19336# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
STRUCTURED HYPERMEDIA APPLICATION DEVELOPMENT MODEL (SHADM): A STRUCTURED MODEL FOR TECHNICAL DOCUMENTATION APPLICATION DESIGN M.S. Thesis
Peter W. Cassell Dec. 1991 126 p
(AD-A244268; AFIT/GIR/LSY/91D-3) Avail: NTIS HC/MF A07 CSCL 12/5

This research was conducted to determine how a Royal Australian Air Force technical maintenance publication could be transformed into a task oriented hypermedia application and to develop a model that could be used for future similar transformations. The model was developed following in-depth analysis of the existing USAF F-15E maintenance publication set and validation was conducted using a prototype developed in HyperWriter, a commercial hypermedia product. The prototype model was based around the performance of three maintenance tasks on an aircraft sub-subsystem and incorporated online user access to the necessary support data for task completion. Publication managers, producers, and users were involved in prototype testing and results validated the model design with limited modification recommendations. Recommended changes were subsequently incorporated in the final model. GRA

N92-19337# Department of Energy, Oak Ridge, TN. Office of Scientific and Technical Information.
THE OFFICE OF INDUSTRIAL TECHNOLOGIES TECHNICAL REPORTS
Jan. 1992 117 p
(DE92-000497; DOE/OSTI-3409-2) Avail: NTIS HC/MF A06

The U.S. Department of Energy's Office of Industrial Technologies (OIT) conducts R&D activities which focus on the objectives of improving energy efficiency and providing for fuel flexibility within U.S. industry in the area of industrial energy conservation. The Office also conducts programs to reduce waste generation, increase recycling efforts, and improve the use of wastes as process feedstocks. An active program of technology transfer and education supports these activities and encourages adoption of new technologies. To accomplish these objectives OIT cooperates with the private sector to identify its technological needs and to share R&D efforts. R&D is conducted to the point that a new technology is shown to work and that it can be transferred to the private sector end-users. This bibliography contains information on all scientific and technical reports sponsored by the DOE Industrial Energy Conservation Program during the years 1988-1990. DOE

N92-19392# California Univ., Los Angeles. Dept. of Computer Science.
VERY LARGE SCALE DISTRIBUTED INFORMATION PROCESSING SYSTEMS Final Report
Gerald J. Popek and Wesley W. Chu 27 Sep. 1991 263 p
(Contract F29601-87-C-0072)
(AD-A243983) Avail: NTIS HC/MF A12 CSCL 12/7

This final report covers the research carried out by the Very Large Distributed Information Processing Systems group at UCLA under DARPA sponsorship during the period 1987-1991. Reflecting this history of the project, this final report covers three primary areas. We will first introduce the distributed operating and file system work, followed by the database research, and finally the Tangram projects. GRA

N92-19468# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
EFFECTIVE DESIGN OF STRATEGIC CONTROL SYSTEMS FOR AIR FORCE INFORMATION MANAGEMENT: A PROGRAM EVALUATION M.S. Thesis
B. B. Cowser Dec. 1991 306 p
(AD-A243930; AFIT/GIR/LSR/91D-5) Avail: NTIS HC/MF A14 CSCL 05/1

Strategic planning and implementation and strategic controls offer organizations powerful and essential tools for proactive management. In information management (IM), they hold the key to successfully navigating the current turbulent environment. This study was conducted in order to evaluate strategic controls in Air Force IM, and to recommend ways to improve them. A model for strategic controls was developed from the literature to serve as a standard for evaluating current programs. Interviews were conducted at three major commands to gather data on the current state of strategic controls. A qualitative analysis methodology was selected, and recommendations include the following points: (1) all organizational levels should be setting strategic objectives and establishing measurement standards based on factors that affect strategic outcomes; (2) planners should analyze and record the premises upon which strategic objectives are based, and review then periodically (especially before taking corrective action) to ensure the premises are still valid; (3) IM should create a clear strategic vision which focuses on defining the organization's intended relationship with every stakeholder; and (4) every management initiative should be thoroughly integrated with the strategy and aligned with the vision. GRA

N92-19519# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THE APPLICATION OF KRIGING FOR CONTROLLED MINIMIZATION OF LARGE DATA SETS M.S. Thesis
Christopher Brodkin Dec. 1991 159 p
(AD-A244121; AFIT/GA/ENY/91D-14) Avail: NTIS HC/MF A08 CSCL 12/3

Frequently, the quantity of data available is much greater than that which can be manipulated in an efficient and timely manner. This can cause several problems. The first, and probably most critical, problem is the excessive on-line storage needs of these huge data sets. Secondly, in the computer animation field, huge data sets may require excessive computational time for generation of each frame of a computer animation. Thirdly, computer screens have a limited resolution and need too much computational time to remove excessive detail from images generated with a greater resolution than can be displayed. Lastly, too much time is required to transmit huge amounts of data from location to location. What is needed is a method of minimizing the data set based on some acceptable level of resolution. This thesis develops the application of kriging for the controlled minimization of large data sets based on a maximum acceptable level of error. Specifically, the geostatistical estimation technique of kriging is used to produce minimal data sets and to estimate the unknown values on an arbitrarily sized grid using as input any data set. All the procedures necessary to improve the accuracy of the estimate as well as the kriging procedure are developed. Using these procedures the entire process can be automated. The techniques are demonstrated using Magnetic Resonance Image data to support minimizing on-line storage requirements. Two concurrent thesis efforts also use the techniques to enlarge satellite photographs and to change the grid resolution of terrain data. GRA

N92-19571# Oak Ridge National Lab., TN.
TEXT ENCODING FOR RETRIEVING SCIENTIFIC AND TECHNICAL INFORMATION
R. A. Strehlow, T. O. Tallant, J. D. Mason, and P. L. Kienlen 1991 19 p Presented at the International Symposium on Terminology and Documentation in Specialized Communication, Ontario, 7-8 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004403; CONF-9110249-1) Avail: NTIS HC/MF A03

The authors have recently proposed a method to manage and to retrieve scientific and technical information based on the encoding of information within the document using Standard Generalized Markup Language (SGML). The encoding will include the scientific and technical information, as well as associated and ancillary scientific data, management data, and other metadata. The work proposed at the Oak Ridge National Laboratory will include tagset selection, document type definition writing, test document encoding, and programming that will permit various views of a document to be made. This paper describes the proposed method and work. Precise retrieval of contained information is conventionally done by means of Boolean searches to retrieve a set of documents that have the probability of containing the desired information. Standardized terminologies have long been a key element in constructing efficient search plans for these searches. Combined with added techniques of corpus selection, author or institution restriction, etc., effective searches can often be constructed. With the increase in corpus size, however, the standard methods become progressively less effective. The planned method described here involves a radically different approach to the retrieval problems. Its objective is the direct retrieval of information. The work of this study will be carried out by a multi-disciplinary team of engineering, scientific, publication, and information specialists. Computer programs to retrieve information from encoded sample documents will be either acquired or written and then tested. At the final stage of the work, after evaluation of the program, plans will be developed to apply the method to a wide range of specialized fields. DOE

N92-19583# Technische Univ., Delft (Netherlands).
DEVELOPING INTERORGANIZATIONAL INFORMATION SYSTEMS Ph.D. Thesis
Folkert Wiebren Wierda 1991 218 p

(ISBN-90-9004069-2; ETN-92-90884) Copyright Avail: NTIS HC/MF A10

Opportunities and problems in developing Interorganizational Information Systems (IIS) are discussed. The literature on the processes of development and of problem solving is investigated to arrive at a model for understanding the joint development of an IIS by actors from distinct organizations. Four case studies are discussed to gain insight into the task of developing IIS: INTIS (International Transport Information System), PICA (Project for Integrated Catalogue Organization), RTN (Rabobank (Dutch commercial banks) Terminal Network), and OSITRANS (Open Systems Interconnection Transport System). A functional design for a support environment to be used in developing IIS and to be implemented into a prototype is derived. A case study evaluation of the prototype is presented. The case situation at the Dutch Railroad Company, Cargo Division, is described. Experiments conducted in this case study are reported and the results analyzed. Findings of the research are evaluated and topics raised are discussed. ESA

N92-19607# RDP, Inc., Waltham, MA.
DMSP SSIES-2 DATA PROCESSING PROGRAM: USER'S GUIDE Scientific Report No. 3, 1 Jun. 1990 - 28 Jun. 1991
J. R. Cornelius, Kevin P. Larson, and Andrew J. Mazzella, Jr. 11 Jul. 1991 58 p
(Contract F19628-89-C-0079)
(AD-A243951; PL-TR-91-2190) Avail: NTIS HC/MF A04 CSCL 12/5

This is a basic utilization guide for the Special Sensor for Ions, Electrons, and Scintillation-2 (SSIES-2) data processing program. This guide reflects the operational aspects of the SSIES-2 program. The SSIES-2 system is a composite sensor for thermal plasma measurements which has been developed as a successor to the SSIES (Special Sensor for Ions, Electrons, and Scintillation) instrument flown on several Defense Meteorological Satellite Program vehicles. This report describes the utilization of the software program SSIES-2, which was developed at Phillips Laboratory from the original Air Force Global Weather Center SSIES processing program. The major components of the SSIES-2 system are the following: (1) the main electronics package (MEP,MP); (2) the drift scintillation meter electronics package (DSM/DM/SM); (3) the electron sensor assembly (EP); (4) the electron electrometer package (EL/AMP); and (5) the ion sensor array assembly (RPA). GRA

N92-19853# National Library of Medicine, Bethesda, MD.
PERMUTED MEDICAL SUBJECT HEADINGS, 1992 Final Report
Aug. 1991 528 p
(PB92-100056; NLM/MED-92/03) Avail: NTIS HC/MF A23 CSCL 05B

Permuted Medical Subject Headings, 1992 is a computer generated display of all terms, i.e., descriptors and cross-references, in the alphabetic list of the National Library of Medicine's Medical Subject Headings (MeSH) for 1992, as well as all check tag and geographic descriptors in the Annotated Alphabetic MeSH, 1992. The Permuted MeSH takes each significant word that appears in each MeSH term and then lists all the MeSH terms in which that word appears. The Permuted MeSH also takes selected word roots and lists all the MeSH terms in which that root appears. Author

N92-19912# Executive Office of the President, Washington, DC. Office of Administration.
PUBLICATIONS OF THE EXECUTIVE OFFICE OF THE PRESIDENT, JANUARY 20, 1989 - SEPTEMBER 30, 1991
Sep. 1991 14 p
(PB91-238782) Avail: NTIS HC/MF A03 CSCL 05B

A list is presented of the publications of the Executive Office of the President for the Bush Administration for the period of 20 Jan. 1989 through 30 Sep. 1991. Author

N92-20011# Naval Postgraduate School, Monterey, CA.
HYPERCARD DATABASE TECHNOLOGY AS APPLIED TO A THREAT EVALUATOR REFERENCE TOOL M.S. Thesis
Frank E. Sutton Mar. 1991 64 p
(AD-A243119) Avail: NTIS HC/MF A04 CSCL 25/5

The paperless ship concept proposed by VADM Metcalf has been advocated at the highest levels in the Navy. ARGOS is a prototype multi-media database system under development at the Naval Postgraduate School in support of this superior concept. This Thesis has implemented a tactical evaluation and assistance tool called Threat Evaluator that can be used as an additional module to the ARGOS system or as a stand alone application. Threat Evaluator automates many of the evaluation and information keeping duties that a Tactical Action Officer is required to perform during normal watchstanding evolutions. It demonstrates the advanced capabilities attainable in a system implemented with economical, off the shelf technology. GRA

N92-20018# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
REGIONAL FINE PARTICLE FIELD STUDY: DATA BASE AND INITIAL RESULTS Report, Jul. 1988 - Jul. 1991
R. L. Bennett and L. Stockburger Nov. 1991 77 p
(PB92-106939; EPA/600/3-91/065) Avail: NTIS HC/MF A05 CSCL 05B

The Fine Particle Network (FPN), a group of rural sites located in the northern two-thirds of the eastern United States, was used to determine fine particle concentrations during selected periods between Aug. 1988 and Feb. 1989 and then continuously from Jul. 1989 - May 1990. Samples from the network collected 24 hours each day were analyzed for the most abundant elements by wavelength dispersive x ray fluorescence (WDXRF). About thirty sites were in operation during each sampling period. The 14 sampling sessions produced 12,859 samples for the 44 stations that were analyzed by WDXRF. Seasonal averages of fine particulate mass and elemental sulfur concentrations were collected. The average concentrations were determined for each of the seven seasons in which samples were collected. Concentrations of both were highest in the summer. The average concentrations for all sites and all collection dates were 15.5 and 1.9 micrograms/cubic meter for the fine particulate mass and elemental sulfur, respectively. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N92-19466# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A GUIDE FOR THE CONSIDERATION OF COMPOSITE MATERIAL IMPACTS ON AIRFRAME COSTS M.S. Thesis
Jeffrey L. Isom Sep. 1991 122 p
(AD-A243928; AFIT/GCA/LSQ/91S-3) Avail: NTIS HC/MF A06 CSCL 05/3

This study provides a guide to cost analysts who must consider the impact of composite materials on airframe costs. A literature review was conducted to determine the availability of cost models which incorporate the effect of composites on cost. A number of models are available, but no individual model was found that is applicable for every situation. In order to provide a baseline upon which analysts can compare model results as well as provide guidance in selecting cost drivers, a Delphi survey was conducted. Questionnaire results indicate that composite weight (as a percentage of total weight), composite part complexity, percentage of composites in load-bearing role, composite part size, fabrication technique, and percentage of composites in a low observable role are all potentially significant cost drivers. Delphi results also indicate that engineering and quality assurance labor hours are quite sensitive to composite weight, while manufacturing and tooling hours are more sensitive to composite part complexity. Finally,

the Delphi results indicate that, although there are some differences in composite labor hour impacts across aircraft type, there are no discernable patterns to the differences. GRA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N92-19110# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Space Communications and Propulsion Systems.
CONSIDERATION OF LEGAL ASPECTS VERSUS MANAGERIAL NEEDS OF PROCUREMENT ASSURANCE
Wolf-Dieter Pilz 1991 17 p Presented at the ESA/ESTEC Symposium, Noordwijk, Netherlands, 16 Apr. 1991
(MBB-UK-0137-91-PUB; ETN-92-90997) Avail: NTIS HC/MF A03

The conflicts existing between legal aspects and managerial needs of procurement assurance are addressed. In the domain of high technologies, quality features which are not accessible for inspections, e.g., reliability, absence of hydrogene embrittlement, stress durability, or environmental resistivity, gain more and more importance. On the example of screw fasteners, it is shown that legislation and justice inpute a bilateral legal relation between the manufacturer or seller on one side, and the customer or user on the other side, in order to distribute the technical risks on both parties. However, modern industrial structures are characterized by interconnected chains of multiple manufacturer/customer relations. Since certain product characteristics (e.g., strength of the welding seam of a pressure vessel or the confidence in a vacuum melted material) cannot be proven on the product itself, the quality of the manufacturing process must be traceable and kept under reasonable control. Procurement assurance offers the most suitable managerial measures to reduce the technical risks which are inherent to any product, manufactured or procured. The recent practice in legislation and justice is surely helpful to distribute the legal liability for technical risks; on the other hand, this practice prevents even essential managerial methods which are necessary to minimize the technical risks. Today's achievements in space technology are inconceivable when the technical risk involved would not have been reduced by means of suitable managerial methods of quality engineering. ESA

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-19238# Arizona Univ., Tucson. Dept. of Materials Science and Engineering.
PROCEEDINGS OF THE 1ST INTERNATIONAL INTERDISCIPLINARY CONFERENCE ON THE INFLUENCE OF CULTURE (JAPANESE/AMERICAN) ON TECHNOLOGICAL INNOVATION Final Report, 1 Nov. 1990 - 31 Oct. 1991
W. D. Kingery 1 Nov. 1991 288 p Conference held in Tucson, AZ, Dec. 1990
(Grant AF-AFOSR-0054-91; AF Proj. 2303)
(AD-A243782; AFOSR-91-0942TR) Avail: NTIS HC/MF A13 CSCL 05/5

Japanese and American scientists, engineers, managers and anthropologists met together to discuss technological innovation in high temperature oxide superconductors, low pressure diamond synthesis and silicon nitride structural ceramics. Discussions focussed on how differences in Japanese and American cultures affect innovation in pre-commercial, nascent and infant commercial advanced materials. Innovation is a complex socio-technical process and no simple generalizations are appropriate. Different national perspectives of the science-technology nexus, different customs with regard to research planning, different 'supplier manufacturer customer' relationships, different views of the learning process, different forms of technological networking, and other cultures differences all impact of the innovation process. GRA

N92-19950# National Science Foundation, Washington, DC.
SCIENCE AND TECHNOLOGY INTEGRATION IN EUROPE AND INFLUENCES ON US-EUROPEAN COOPERATION: A REPORT OF THE NATIONAL SCIENCE BOARD COMMITTEE ON EUROPE IN 1992 Final Report
F. K. Willenbrock, R. E. Bradshaw, D. N. Langenberg, J. H. Moore, and J. W. Lyons Nov. 1990 41 p
(PB92-100676; NSB-90-172) Avail: NTIS HC/MF A03 CSCL 05A

Science and Technology (S&T) in Western Europe is quickly evolving toward an umbrella structure for strategic policy planning, research coordination, and resources development and allocation. The EC Commission is becoming the largest source of funding and administrative and planning resources for such cooperation. It is assuming a growing but contentious role in stimulating, guiding, and making this cooperative paradigm operational. The Commission is also moving quickly to develop EC policies and activities for international cooperation in S&T, particularly in fields such as environmental protection and global warming. However, the EC member nations' primary responsibility for research support, facilities and human resources remains paramount; the EC superstructure is to be integrative, and supplementary of member state S&T activity. This implies challenges for U.S. decision makers, by way of: assessing the pace and directions of European S&T integration; achieving U.S. interagency consensus on exercising U.S. influence on that process; and allocating resources among bilateral and multilateral cooperative activities. Policy and operational recommendations are provided for appropriate U.S. government responses. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-19377# European Southern Observatory, Garching (Germany, F.R.).
[ACTIVITIES REPORT OF THE EUROPEAN SOUTHERN OBSERVATORY] Annual Report, 1990
1991 121 p In ENGLISH, FRENCH, and GERMAN
(ISSN-0531-4496; ETN-92-90824) Avail: NTIS HC/MF A06

The facilities used or under development and the organizational means to support the actions and technology are reviewed. The continued development of the La Silla Observatory and the unfolding of the VLT (Very Large Telescope) Program are reported. Research reports cover the European Coordinating Facility for the Space Telescope (ST-ECF), collaboration between ESO (European Southern Observatory) and the University of Chile, image processing, ESO conferences and workshops, and sky surveys. Facilities discussed include the telescopes, infrastructure, optical, and infrared instrumentation. Organizational, financial, and administrative matters are reported. ESA

N92-19605 Harvard Univ., Cambridge, MA.
HIGH-RESOLUTION OBSERVATIONS OF THE GLOBULAR CLUSTER NGC 7099 Ph.D. Thesis
Bruce Jones Sams, III 1991 242 p
Avail: Univ. Microfilms Order No. DA9132031

The globular cluster NGC 7099 is a prototypical collapsed core cluster. Through a series of instrumental, observational, and theoretical observations, I have resolved its core structure using a ground based telescope. The core has a radius of 2.15 arcsec when imaged with a V band spatial resolution of 0.35 arcsec. Initial attempts at speckle imaging produced images of inadequate signal to noise and resolution. To explain these results, a new, fully general signal-to-noise model has been developed. It properly accounts for all sources of noise in a speckle observation, including aliasing of high spatial frequencies by inadequate sampling of the image plane. The model, called Full Speckle Noise (FSN), can be used to predict the outcome of any speckle imaging experiment. A new high resolution imaging technique called ACT (Atmospheric Correlation with a Template) was developed to create sharper astronomical images. ACT compensates for image motion due to atmospheric turbulence. ACT is similar to the Shift and Add algorithm, but uses apriori spatial knowledge about the image to further constrain the shifts. In this instance, the final images of NGC 7099 have resolutions of 0.35 arcsec from data taken in 1 arcsec seeing. The PAPA (Precision Analog Photon Address) camera was used to record data. It is subject to errors when imaging cluster cores in a large field of view. The origin of these errors is explained, and several ways to avoid them proposed. New software was created for the PAPA camera to properly take flat field images taken in a large field of view. Absolute photometry measurements of NGC 7099 made with the PAPA camera are accurate to 0.1 magnitude. Luminosity sampling errors dominate surface brightness profiles of the central few arcsec in a collapsed core cluster. These errors set limits on the ultimate spatial accuracy of surface brightness profiles. The limits apply even to images of arbitrarily high resolution; even to a perfectly functioning Hubble Space Telescope, as long as bright stars are not subtracted from the image. For the cusp cluster NGC 7099, if the core radius is zero (a pure cusp), the limiting resolution is 0.38 arcsec, and the minimum detectable core radius is 1.45 arcsec. Dissert. Abstr.

N92-19728*# Texas Univ., Austin. Center for Space Research.
PRECISION GPS EPHEMERIDES AND BASELINES Final Report, Jan. 1988 - Apr. 1991
25 Feb. 1992 169 p
(Grant NAG5-940)
(NASA-CR-189924; NAS 1.26:189924) Avail: NTIS HC/MF A08 CSCL 03A

The required knowledge of the Global Positioning System (GPS) satellite position accuracy can vary depending on a particular application. Application to relative positioning of receiver locations on the ground to infer Earth's tectonic plate motion requires the most accurate knowledge of the GPS satellite orbits. Research directed towards improving and evaluating the accuracy of GPS satellite orbits was conducted at the University of Texas Center for Space Research (CSR). Understanding and modeling the forces acting on the satellites was a major focus of the research. Other aspects of orbit determination, such as the reference frame, time system, measurement modeling, and parameterization, were also investigated. Gravitational forces were modeled by truncated versions of extant gravity fields such as, Goddard Earth Model (GEM-L2), GEM-T1, TEG-2, and third body perturbations due to the Sun and Moon. Nongravitational forces considered were the solar radiation pressure, and perturbations due to thermal venting and thermal imbalance. At the GPS satellite orbit accuracy level required for crustal dynamic applications, models for the nongravitational perturbation play a critical role, since the gravitational forces are well understood and are modeled adequately for GPS satellite orbits. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

N92-19720# California Univ., Berkeley. Lawrence Berkeley Lab.
THE Fe-L SHELL SPECTRUM IN COMPACT ASTROPHYSICAL X RAY SOURCES
D. A. Liedahl, S. M. Kahn, W. H. Goldstein, and A. L. Osterheld (Lawrence Livermore National Lab., CA.) 2 Dec. 1991 9 p Presented at the 7th International Symposium on High Voltage Engineering (ISH-7), Dresden, Fed. Republic of Germany, 26-30 Aug. 1991
(Contract W-7405-eng-48)
(DE92-005245; UCRL-JC-109165; CONF-910810-6) Avail: NTIS HC/MF A02

Compact X ray sources derive their luminosities from the conversion of gravitational potential energy through accretion. A centrally produced hard X ray continuum photoionizes the surrounding accretion flow, which can produce discrete X ray emission. To date, as applied to compact X ray sources, a detailed diagnostic approach to the analysis of spectroscopic data has been largely ineffective, owing to the limited quality of available line spectra and the lack of appropriate models of X ray line emission in the presence of an ionizing continuum radiation field. We are involved in an atomic modeling program to investigate the discrete spectral response to variations in ambient plasma conditions, with the aim of establishing a new set of plasma diagnostics appropriate to this physical regime. We discuss the physical mechanisms and applications of several of the diagnostics which have been discovered in the Fe L-shell spectrum, under conditions appropriate to X ray photoionized plasmas. DOE

N92-19750*# Eloret Corp., Sunnyvale, CA.
IMPACT CONTRIBUTION OF PREBIOTIC REACTANTS TO EARTH Technical Report, 1 Apr. - 31 Dec. 1991
Hans R. Aggarwal 5 Mar. 1992 30 p
(Contract NCC2-722)
(NASA-CR-189950; NAS 1.26:189950) Avail: NTIS HC/MF A03 CSCL 03B

It is proposed that the AIB amino acid at the K/T boundary were synthesized during entry of a comet. However, whether they were synthesized or supplied directly from space, the concentration of amino acids in the shallow K/T sea would have been about 10(exp -7) M. It is probable that clays were the dominant sinks for the amino acids in the K/T sea and in the primordial ocean. Because clay removed amino acids from sea water quickly, the amino acid contribution must be studied from individual comets in order to evaluate the effectiveness of comets for chemical evolution. Such an evaluation shows that comets would have produced amino acid concentration higher than equilibrium concentrations of amino acid from corona discharge at all times preceding the age of the oldest fossils. The perferred sites for chemical evolution of cometary amino acids are in cloud drops and tide pools where the concentration of amino acids would have been the highest. Life could have originated at the surface even during periods of intense bombardment of the earth before 3.8 billion years ago. Author

N92-19818# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
STRONG-FIELD TESTS OF RELATIVISTIC GRAVITY AND BINARY PULSARS
T. Damour and J. H. Taylor Sep. 1991 67 p Prepared in cooperation with Princeton Univ., NJ
(PB92-115567; IHES/P/91/63) Avail: NTIS HC/MF A04 CSCL 03B

Observations of pulsars in gravitationally bound binary systems provide a unique opportunity for testing the strong-field regime of relativistic gravity. The authors present a detailed account of the 'parameterized post-Keplerian' (PPK) formalism, a general phenomenological framework designed to extract the maximum

possible information from pulsar timing and pulse-structure data. The PPK approach allows dynamical information to be obtained from the data in a theory-independent way, and encoded in a certain number of fitted post-Keplerian parameters. The authors show that as many as 19 such parameters can be measured, under favorable conditions, giving access to 15 possible tests of relativistic gravity. The authors isolate and quantify the theoretical content of these tests by deriving, within the framework of generic boost-invariant theories, expressions linking the phenomenological parameters to the inertial masses of the pulsar and its companion, and to the polar angles of the spin axis of the pulsar. The prospects for extracting some of these tests from observations of known or yet-to-be-discovered binary pulsars is quantitatively assessed through numerical simulations. GRA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-19529 California Inst. of Tech., Pasadena.
ANALYSIS AND IMPLICATIONS OF LARGE MARTIAN AND TERRESTRIAL LANDSLIDES Ph.D. Thesis
Philip John Shaller 1991 687 p
Avail: Univ. Microfilms Order No. DA9137290

Two long-standing scientific problems are addressed: the mechanism(s) of long-runout in large landslides; and the activity of water on the surface of Mars late in its history. Long-runout landslides form significant geologic risks. The factors that control the initiation and runout of large landslides wherever they occur are examined. A second objective was to use Martian landslides to gauge the activity of liquid water on Mars' surface over the past quarter of its history. To achieve these objectives, I made field observations of six moist and dry landslides in the western United States, I studied all the high-resolution Viking Orbiter images for large landslides on Mars, and I collated all the available literature data on large landslides to develop the clearest view possible of the nature of the large landslide process. I then used this information to evaluate all the previously published models of long-runout, and to develop my own theory. I conclude that large landslides primarily slide and spread into place over fluidized natural basal lubricants. This concept follows upon the air-layer lubrication theory of Shreve, but does not call upon a gas lubricant. Rather, the lubricants appear to be fine-grained materials from the substrate or from the landslide debris itself that deform plastically at the high shear stresses and strain rates present beneath large rapid landslides. Large dry landslides grade into moist debris flows as water becomes incorporated into their fine-grained component. Moist and dry landslides differ markedly in sedimentology and morphology, but not in a variety of quantitative relations. Seven landslide events on Mars appear to have involved water during runout, based on comparisons with water-bearing landslides of similar morphology and volume on Earth. These deposits occur primarily in Valles Marineris and indicate that liquid water has been sporadically available on Mars at various times over approximately the last one billion years of its history.
Dissert. Abstr.

N92-19928*# Institute for Scientific Research, Lexington, MA.
THEORETICAL STUDIES OF IMPORTANT PROCESSES IN PLANETARY AND COMET ATMOSPHERES Final Report, 1 Sep. 1988 - 31 Oct. 1991
Steven L. Guberman 1991 10 p
(Grant NAGw-1404)
(NASA-CR-186588; NAS 1.26:186588) Avail: NTIS HC/MF A02 CSCL 03B

The dissociative recombination (DR) of the AB(+) molecular ion with an electron has been shown to be an important component in the detailed interpretation of planetary ionosphere data. A first principles theoretical approach is developed for calculating the DR cross sections and rates for AB(+) molecular ions. The calculations focus on O2(+) and N2(+) DR, and are the first to include the indirect DR mechanism (Ryberg vibrational levels below v = 0 level of ion) for a molecule larger than H2(+). The importance of electron capture width in calculating the cross sections and rates is also examined. Electron capture widths are given for all states of O2 that are of importance to DR (lowest 10 vibrational levels of ion). Knowledge of the details of dissociative recombination will be needed for interpretation of data from future interplanetary and comet atmospheric studies. H.A.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-19216# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SUNSPOTS, SOLAR RADIO NOISE, SOLAR EUV AND IONOSPHERIC foF2
Rajaram Purushottam Kane Oct. 1991 15 p Submitted for publication
(INPE-5287-PRE/1692) Avail: NTIS HC/MF A03

Plots of monthly median noon time foF2 values at Manila, Kodaikanal and Vanimo versus solar EUV flux (170 to 190 A), smoothed sunspot number R sub 12 and smoothed solar radio noise (10.7 cm) flux indicate saturation effects in the foF2 versus sunspot plots. The saturation diminishes in the foF2 versus solar radio noise plots and disappears for foF2 versus solar EUV plots. Thus, in the absence of EUV data, solar radio noise could be a reasonably good substitute, better than sunspots, for time scales of one month, or more. Author

N92-19396# California Univ., San Diego, La Jolla.
REMOTE SENSING OF INNER HELIOSPHERIC PLASMAS Annual Technical Report, 15 Nov. 1990 - 14 Nov. 1991
Bernard V. Jackson 14 Nov. 1991 22 p
(Grant AF-AFOSR-0091-91; AF Proj. 2311)
(AD-A244408; AFOSR-91-1004TR) Avail: NTIS HC/MF A03 CSCL 03/2

Solar disturbances produce major effects on the corona, the solar wind, the interplanetary medium, and the Earth along with its magnetosphere. We have developed new techniques for studying plasma disturbances in the inner heliosphere by remotely sensing them. These techniques use data from the HELIOS spacecraft zodiacal light photometers, the ISEE-3 spacecraft kilometer radio-wave experiment, and a variety of other spacecraft and ground-based instruments. The zodiacal light photometers on board the two HELIOS spacecraft (data coverage from 1974 to 1986) provide the first good information about the heliospheric masses and shapes of propagating disturbances. Metric and kilometric type II and type III radiation caused by shock waves and fast moving electrons respectively are another way to remotely sense the structures which propagate outward from the Sun. The best kilometric radio wave sensing of inner heliospheric plasma is available from the ISEE-3 spacecraft. The investigations into the physics of the disturbances sensed by these techniques and the ability to forecast their occurrences are well underway. GRA

N92-19534# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LONG-TERM VARIATION OF SOLAR UVB (290-330 nm) OBSERVED AT THE EARTH'S SURFACE
Rajaram Purushottam Kane Oct. 1991 24 p Submitted for publication
(INPE-5289-PRE/1694) Avail: NTIS HC/MF A03

During solar cycle 21 (1976-86), the primary solar irradiance at approx. 300 nm was steady during 1980-82, and thereafter decreased up to 1986 by only approx. 2-3 percent. The stratospheric ozone in middle latitudes had a quasi-biennial oscillation (QBO) of approx. 3-4 percent in this interval, but the

long term ozone trend was less than 3 percent per decade, which could result in a UVB increase of only approx. 5-6 percent per decade. Thus, the combined effect of changes in the primary solar irradiance and ozone changes could be an increase of 5-6 percent in UVB observed at ground during 1977-81 and a steady level during 1981-86. During 1976-86, the average cloudiness changed by less than 5 percent, indicating UVB changes of 5 percent or less on this count. The aerosol level was almost constant during 1976-82 and increased abruptly in 1982 due to the El Chichon eruption and decayed slowly up to 1986. Thus, due to aerosols only, the UVB was expected to be constant during 1976-82, decrease sharply in 1982, and recoup slowly thereafter. Measurements of clear sky solar UVB at ground made at Jungfraujoch (Swiss Alps, 47 degrees N, 8 degrees E) during 1981-89 and at Rockville, USA (39 degrees N, 77 degrees W) were not comparable between themselves and did not follow the above expected patterns. Neither did the all-day meter UVB measurements at Philadelphia, USA (40 degrees N, 75 degrees W) and Minneapolis, USA (45 degrees N, 93 degrees W). We suspect that some of these measurements are erroneous. This needs further detailed scrutiny. Author

N92-19628# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
CIRCUMSOLAR RADIATION DATA: THE LAWRENCE BERKELEY LABORATORY REDUCED DATA BASE
J. E. Noring, D. F. Grether, and A. J. Hunt Dec. 1991 17 p Prepared in cooperation with Lawrence Berkeley Lab., CA
(Contracts DE-AC02-83CH-10093; DE-AC03-76SF-00098)
(DE92-001161; NREL/TP-262-4429; LBL-29683) Avail: NTIS HC/MF A03

This report describes the content and format of a circumsolar radiation data base assembled by Lawrence Berkeley Laboratory. This 200-megabyte data base contains detailed intensity profiles of the solar and circumsolar region (out to 3 degrees from the sun's center), the total and spectrally divided direct normal radiation data, and the total hemispherical solar radiation in the horizontal plane and the plane facing the sun. Data are available for 11 locations in the United States covering 1976 to 1981. Measurements were made by four automatic scanning instruments called circumsolar telescopes that operated about 16 hours per day. This data base, the Reduced Data Base, was generated from a larger set to provide data in a more manageable form. DOE

N92-19774*# California Univ., Irvine. Dept. of Physics.
RESEARCH IN SOLAR PLASMA THEORY Final Technical Report, 1 Jun. 1980 - 30 Nov. 1991
Gerard VanHoven 28 Feb. 1992 75 p
(Grant NAGw-93)
(NASA-CR-189934; NAS 1.26:189934) Avail: NTIS HC/MF A04 CSCL 03B

The main thrust and significance of our research results are presented. The topics covered include: (1) coronal structure and dynamics; (2) coronal heating; (3) filament formation; and (4) flare energy release. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N92-19056*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
CONTINUUM RADIATION IN PLANETARY MAGNETOSPHERES
W. S. Kurth Dec. 1991 46 p Presented at the 3d International Workshop on Radio Emissions from Planetary Magnetospheres, Graz, Austria, 2-4 Sep. 1991
(Contracts JPL-957723; JPL-959193)
(NASA-CR-189903; NAS 1.26:189903; U-of-Iowa-91-29) Avail: NTIS HC/MF A03 CSCL 03B

With the completion of the Voyager tour of the outer planets, radio and plasma wave instruments have executed the first survey of the wave spectra of Earth, Jupiter, Saturn, Uranus, and Neptune. One of the most notable conclusions of this survey is that there is a great deal of qualitative similarity in both the plasma wave and radio wave spectra from one magnetosphere to the next. In particular, in spite of detailed differences, most of the radio emissions at each of the planets have been tentatively classified into two primary categories. First, the most intense emissions are generally associated with the cyclotron maser instability. Second, a class of weaker emissions can be found at each of the magnetospheres which appears to be the result of conversion from intense electrostatic emissions at the upper hybrid resonance frequency into (primarily) ordinary mode radio emission. It is this second category, often referred to as nonthermal continuum radiation, which we will discuss in this review. We review the characteristics of the continuum spectrum at each of the planets, discuss the source region and direct observations of the generation of the emissions where available, and briefly describe the theories for the generation of the emissions. Over the past few years evidence has increased that the linear mode conversion of electrostatic waves into the ordinary mode can account for at least some of the continuum radiation observed. There is no definitive evidence which precludes the possibility that a nonlinear mechanism may also be important. Author

99 GENERAL

N92-19058*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
RESEARCH AND TECHNOLOGY 1991 ANNUAL REPORT
1991 156 p
(NASA-TM-103825; NAS 1.15:103825) Avail: NTIS HC/MF A08 CSCL 05B

As the NASA Center responsible for assembly, checkout, servicing, launch, recovery, and operational support of Space Transportation System elements and payloads, NASA Kennedy is placing increasing emphasis on the center's research and technology program. In addition to strengthening those areas of engineering and operations technology that contribute to safer, more efficient, and more economical execution of the current mission, the technical tools are being developed which are needed to execute the center's mission relative to future programs. The Engineering Development Directorate encompasses most of the labs and other center resources that are key elements of research and technology program implementation and is responsible for implementation of the majority of the projects in this Kennedy Space Center 1991 annual report. Author

N92-19306*# University of Central Florida, Orlando. Dept. of Engineering.
NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM. 1991 RESEARCH REPORTS
E. Ramon Hosler, ed., Mark A. Beymer, ed., and Dennis W. Armstrong, ed. (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.) Nov. 1991 789 p Fellowship program held in Cocoa Beach, FL, 3 Jun. - 9 Aug. 1991; sponsored by NASA, Washington Sponsored by NASA. Kennedy Space Center
(Grant NGT-60002)
(NASA-CR-189744; NAS 1.26:189744) Avail: NTIS HC/MF A99 CSCL 05B

Reports from the NASA/ASEE Summer Faculty Fellowship Program are presented. The editors are responsible for selecting appropriately qualified faculty to address some of the many problems of current interest to NASA Kennedy. Some representative titles are as follows: Development of an Accelerated

Test Method for the Determination of Susceptibility to Atmospheric Corrosion; Hazardous Gas Leak Analysis in the Space Shuttle; Modeling and Control of the Automated Radiator Inspection Device; Study of the Finite Element Software Packages at KSC; Multispectral Image Processing for Plants; Algorithms for Contours Depicting Static Electric Fields during Adverse Weather Conditions; Transient Study of a Cryogenic Hydrogen Filling System; and Precision Cleaning Verification of Nonvolatile Residues by using Water, Ultrasonics, and Turbidity Analyses. For individual titles, see N92-19307 through N92-19324.

N92-19307*# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.

DEVELOPMENT OF AN ACCELERATED TEST METHOD FOR THE DETERMINATION OF SUSCEPTIBILITY TO ATMOSPHERIC CORROSION **c26**

John R. Ambrose *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 1-26 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 11F

The theoretical rationale is presented for use of a repetitive cyclic current reversal voltammetric technique for characterization of localized corrosion processes, including atmospheric corrosion. Applicability of this proposed experimental protocol is applied to characterization of susceptibility to crevice and pitting corrosion, atmospheric corrosion and stress corrosion cracking. Criteria upon which relative susceptibility is based were determined and tested using two iron based alloys commonly in use at NASA-Kennedy; A36 (a low carbon steel) and 4130 (a low alloy steel). Practicality of the procedure was demonstrated by measuring changes in anodic polarization behavior during high frequency current reversal cycles of 25 cycles per second with 1 mA/sq cm current density amplitude in solutions containing Cl anions. The results demonstrated that, due to excessive polarization which affects conductivity of barrier corrosion product layers, A36 was less resistant to atmospheric corrosion than its 4130 counterpart; behavior which was also demonstrated during exposure tests. Author

N92-19308*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.

HAZARDOUS GAS LEAK ANALYSIS IN THE SPACE SHUTTLE **c16**

Ronald G. Barile *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 27-64 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 22B

Helium tests of the main propulsion system in the Space Shuttle and on hydrogen leaks are examined. The hazardous gas detection system (HGDS) in the mobile launch pad uses mass spectrometers (MS) to monitor the shuttle environment for leaks. The mass spectrometers are fed by long tubes to sample gas from the payload bay, mid-body, aft engine compartment, and external tank. The purpose is to improve the HGDS, especially in its potential for locating cryogen leaks. Pre-existing leak data was analyzed for transient information to determine if the leak location could be pinpointed from test data. A rapid response leak detection experiment was designed, built, and tested. Large eddies and vortices were visually seen with Schlieren imaging, and they were detected in the time plots of the various instruments. The response time of the MS was found in the range of 0.05 to 0.1 sec. Pulsed concentration waves were clearly detected at 25 cycles per sec by spectral analysis of MS data. One conclusion is that the backup HGDS sampling frequency should be increased above the present rate of 1 sample per second. Author

N92-19309*# Towson State Univ., MD. Dept. of Physics.

REFLECTION EFFECTS IN MULTIMODE FIBER SYSTEMS UTILIZING LASER TRANSMITTERS **c74**

Harry E. Bates *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 65-115 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 20F

A number of optical communication lines are now in use at NASA-Kennedy for the transmission of voice, computer data, and video signals. Now, all of these channels use a single carrier wavelength centered near 1300 or 1550 nm. Engineering tests in the past have given indications of the growth of systematic and random noise in the RF spectrum of a fiber network as the number of connector pairs is increased. This noise seems to occur when a laser transmitter is used instead of a LED. It has been suggested that the noise is caused by back reflections created at connector fiber interfaces. Experiments were performed to explore the effect of reflection on the transmitting laser under conditions of reflective feedback. This effort included computer integration of some of the instrumentation in the fiber optic lab using the Lab View software recently acquired by the lab group. The main goal was to interface the Anritsu Optical and RF spectrum analyzers to the MacIntosh II computer so that laser spectra and network RF spectra could be simultaneously and rapidly acquired in a form convenient for analysis. Both single and multimode fiber is installed at Kennedy. Since most are multimode, this effort concentrated on multimode systems. Author

N92-19310*# University of Central Florida, Orlando. Dept. of Industrial Engineering and Management Systems.

INFORMATION FLOW ANALYSIS OF LEVEL 4 PAYLOAD PROCESSING OPERATIONS **c16**

Mary E. Danz *In its* NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 116-140 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 22B

The Level 4 Mission Sequence Test (MST) was studied to develop strategies and recommendations to facilitate information flow. Recommendations developed as a result of this study include revised format of the Test and Assembly Procedure (TAP) document and a conceptualized software based system to assist in the management of information flow during the MST. Author

N92-19311*# Clemson Univ., SC. Dept. of Electrical and Computer Engineering.

MODELING AND CONTROL OF THE AUTOMATED RADIATOR INSPECTION DEVICE **c37**

Darren Dawson *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 141-170 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 13I

Many of the operations performed at the Kennedy Space Center (KSC) are dangerous and repetitive tasks which make them ideal candidates for robotic applications. For one specific application, KSC is currently in the process of designing and constructing a robot called the Automated Radiator Inspection Device (ARID), to inspect the radiator panels on the orbiter. The following aspects of the ARID project are discussed: modeling of the ARID; design of control algorithms; and nonlinear based simulation of the ARID. Recommendations to assist KSC personnel in the successful completion of the ARID project are given. Author

N92-19312*# Oklahoma State Univ., Stillwater. Dept. of Electrical and Computer Engineering.

FRAME SHIFT/WARP COMPENSATION FOR THE ARID ROBOT SYSTEM **c37**

Carl D. Latino *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 171-209 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 13I

The Automatic Radiator Inspection Device (ARID) is a system aimed at automating the tedious task of inspecting orbiter radiator panels. The ARID must have the ability to aim a camera accurately at the desired inspection points, which are in the order of 13,000. The ideal inspection points are known; however, the panel may

be relocated due to inaccurate parking and warpage. A method of determining the mathematical description of a translated as well as a warped surface by accurate measurement of only a few points on this surface is developed here. The method uses a linear warp model whose effect is superimposed on the rigid body translation. Due to the angles involved, small angle approximations are possible, which greatly reduces the computational complexity. Given an accurate linear warp model, all the desired translation and warp parameters can be obtained by knowledge of the ideal locations of four fiducial points and the corresponding measurements of these points on the actual radiator surface. The method uses three of the fiducials to define a plane and the fourth to define the warp. Given this information, it is possible to determine a transformation that will enable the ARID system to translate any desired inspection point on the ideal surface to its corresponding value on the actual surface. Author

N92-19313*# Memphis State Univ., TN. Dept. of Mechanical Engineering.

INVESTIGATION OF THE FINITE ELEMENT SOFTWARE PACKAGES AT KSC **c61**

Chu-Ho Lu *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 210-235 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 09B

The useful and powerful features of NASTRAN and three real world problems for the testing of the capabilities of different NASTRAN versions are discussed. The test problems involve direct transient analysis, nonlinear analysis, and static analysis. The experiences in using graphics software packages are also discussed. It was found that MSC/XL can be more useful if it can be improved to generate picture files of the analysis results and to extend its capabilities to support finite element codes other than MSC/NASTRAN. It was found that the current version of SDRC/I-DEAS (version VI) may have bugs in the module 'Data Loader'. Author

N92-19314*# Purdue Univ., West Lafayette, IN. Dept. of Agricultural Engineering.

MULTISPECTRAL IMAGE PROCESSING FOR PLANTS **c43**

Gaines E. Miles *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 236-260 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 02C

The development of a machine vision system to monitor plant growth and health is one of three essential steps towards establishing an intelligent system capable of accurately assessing the state of a controlled ecological life support system for long-term space travel. Besides a network of sensors, simulators are needed to predict plant features, and artificial intelligence algorithms are needed to determine the state of a plant based life support system. Multispectral machine vision and image processing can be used to sense plant features, including health and nutritional status. Author

N92-19315*# Baylor Univ., Waco, TX. Dept. of Engineering and Computer Science.

KATE'S MODEL VERIFICATION TOOLS **c63**

Steve Morgan *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 261-317 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 09B

Kennedy Space Center's Knowledge-based Autonomous Test Engineer (KATE) is capable of monitoring electromechanical systems, diagnosing their errors, and even repairing them when they crash. A survey of KATE's developer/modelers revealed that they were already using a sophisticated set of productivity enhancing tools. They did request five more, however, and those make up the body of the information presented here: (1) a transfer function code fitter; (2) a FORTRAN-Lisp translator; (3) three existing structural consistency checkers to aid in syntax checking their modeled device frames; (4) an automated procedure for calibrating knowledge base admittances to protect KATE's hardware mockups from inadvertent hand valve twiddling; and (5) three alternatives for the 'pseudo object', a programming patch that currently apprises KATE's modeling devices of their operational environments. Author

N92-19316*# Christian Brothers Coll., Memphis, TN. Dept. of Chemical Engineering.

EVALUATION OF SURLYN 8920 AS PHE VISOR MATERIAL AND EVALUATIONS OF NEW ADHESIVES FOR IMPROVING BONDING BETWEEN TEFLON AND STAINLESS STEEL AT CRYOGENIC TEMPERATURE **c27**

Asit K. Ray *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 318-343 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 11B

Two studies are presented, and in the first study, Surlyn 8920 (an ionic and amorphous low density polyethylene made by Dupont) was evaluated as a possible replacement of Plexyglass G as PHE visor material. Four formulations of the polymer were made by adding different amounts of UV stabilizer, energy quencher, and antioxident in a Brabender Plasticorder. The formulated polymers were molded in the form of sheets in a compression molder. Cut samples from the molded sheets were exposed in a weatherometer and tested on Instron Tensile Tester for strength and elongation. Specially molded samples of the formulated polymers were subjected to Charpy Impact Tests. In the second study, preliminary evaluations of adhesives for improvement of bonding between Teflon and stainless steel (SS) were performed. Kapton, a high temperature polyimide made by Dupont, and a rubber based adhesive made by Potter Paint Co., were evaluated against industrial quality epoxy, the current material used to bond Teflon and SS. The degreased surfaces of the SS discs were etched mechanically, with a few of these etched chemically. The surfaces of the SS discs were etched mechanically, with a few of these etched chemically. Bonding strengths were evaluated using lap shear tests on the Instron Tensile Tester for the samples bonded by Kapton and industrial quality epoxy. Bond strengths were also evaluated using a pull test on the Instron for the samples bonded by Potter adhesive (CWL-152) and industrial quality epoxy. Based on limited lap shear data, Kapton gave bond strength favorable compared to that of industrial epoxy. Based on limited pull test data, Kapton bonded and CWL-152 bonded samples showed poor strength compared to epoxy bonded sample. Author

N92-19317*# Wisconsin-Stout Univ., Menomonie. Dept. of Physics.

ALGORITHMS FOR CONTOURS DEPICTING STATIC ELECTRIC FIELDS DURING ADVERSE WEATHER CONDITIONS **c47**

John T. Rompala *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 344-376 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 04B

A flexible and functional analytical tool is developed for the study of electric fields during adverse weather conditions. This tool is designed for use by members of the Atmospheric Science Group as part of their overall effort to appraise environmental conditions during these situations. It is also used to illustrate approaches open to those interested in the study of the physics of ambient electric field phenomena. Computer resources of KSC are coordinated with original software to produce contour interpretations of electric field data available from a grid of field mills spanning the region. Three model algorithms are presented and examples are given illustrating the system design, flexibility, and utility. Author

N92-19318*# Norwalk State Technical Coll., CT. Dept. of Mathematics.

TRANSIENT STUDY OF A CRYOGENIC HYDROGEN FILLING SYSTEM **c09**

Howard Schleier *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 377-410 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 14B

An investigation was made of producing a workable model for the transient analysis of a cryogenic hydrogen filling system. A series of programs and subprograms defining the momentum, mass, and energy balances and the physical properties, transport properties, and their interactions were devised.The program was modified for a simple theoretical test fluid. Exhaustive runs and modifications were made and at this point no stability was achieved except in trivial cases. Author

N92-19319*# Portland State Univ., OR. Dept. of Computer Science.

DEVELOPMENT OF A COMMON USER INTERFACE FOR THE LAUNCH DECISION SUPPORT SYSTEM c15

Jean C. Scholtz *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 411-440 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 14B

The Launch Decision Support System (LDSS) is software to be used by the NASA Test Director (NTD) in the firing room during countdown. This software is designed to assist the NTD with time management, that is, when to resume from a hold condition. This software will assist the NTD in making and evaluating alternate plans and will keep him advised of the existing situation. As such, the interface to this software must be designed to provide the maximum amount of information in the clearest fashion and in a timely manner. This research involves applying user interface guidelines to a mature prototype of LDSS and developing displays that will enable the users to easily and efficiently obtain information from the LDSS displays. This research also extends previous work on organizing and prioritizing human-computer interaction knowledge. Author

N92-19320*# South Carolina Univ., Columbia. Dept. of Physics.

PRECISION CLEANING VERIFICATION OF NONVOLATILE RESIDUES BY USING WATER, ULTRASONICS, AND TURBIDITY ANALYSES c31

S. Ballou Skinner *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 441-468 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 13H

Chlorofluorocarbons (CFC's) in the atmosphere are believed to present a major environmental problem because they are able to interact with and deplete the ozone layer. NASA has been mandated to replace chlorinated solvents in precision cleaning, cleanliness verification, and degreasing of aerospace fluid systems hardware and ground support equipment. KSC has a CFC phase-out plan which provides for the elimination of over 90 percent of the CFC and halon use by 1995. The Materials Science Laboratory and KSC is evaluating four analytical methods for the determination of nonvolatile residues removal by water: (1) infrared analyses using an attenuated total reflectance; (2) surface tension analyses, (3) total organic content analyses, and (4) turbidity analyses. This research project examined the ultrasonic-turbidity responses for 22 hydrocarbons in an effect to determine: (1) if ultrasonics in heated water (70 C) will clean hydrocarbons (oils, greases, gels, and fluids) from aerospace hardware; (2) if the cleaning process by ultrasonics will simultaneously emulsify the removed hydrocarbons in the water; and (3) if a turbidimeter can be used successfully as an analytical instrument for quantifying the removal of hydrocarbons. Sixteen of the 22 hydrocarbons tested showed that ultrasonics would remove it at least 90 percent of the contaminated hydrocarbon from the hardware in 10 minutes or less giving a good ultrasonic-turbidity response. Six hydrocarbons had a lower percentage removal, a slower removal rate, and a marginal ultrasonic-turbidity response. Author

N92-19321*# State Univ. of New York, Farmingdale. Dept. of Mechanical Engineering.

GENERIC TECHNIQUES FOR THE CALIBRATION OF ROBOTS WITH APPLICATION OF THE 3-D FIXTURES AND STATISTICAL TECHNIQUE ON THE PUMA 500 AND ARID ROBOTS c37

Hazem Tawfik *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 469-506 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 13I

A relatively simple, inexpensive, and generic technique that could be used in both laboratories and some operation site environments is introduced at the Robotics Applications and Development Laboratory (RADL) at Kennedy Space Center (KSC). In addition, this report gives a detailed explanation of the set up procedure, data collection, and analysis using this new technique that was developed at the State University of New York at Farmingdale. The technique was used to evaluate the repeatability, accuracy, and overshoot of the Unimate Industrial Robot, PUMA 500. The data were statistically analyzed to provide an insight into the performance of the systems and components of the robot. Also, the same technique was used to check the forward kinematics against the inverse kinematics of RADL's PUMA robot. Recommendations were made for RADL to use this technique for laboratory calibration of the currently existing robots such as the ASEA, high speed controller, Automated Radiator Inspection Device (ARID) etc. Also, recommendations were made to develop and establish other calibration techniques that will be more suitable for site calibration environment and robot certification. Author

N92-19322*# California State Univ., Sacramento. Dept. of Mechanical Engineering.

LOW FLOW VORTEX SHEDDING FLOW METER FOR HYPERGOLICS/ALL MEDIA c35

Ngo Dinh Thinh *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 507-534 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 14B

A family of vortex shedding flow meters, for measurement of hypergol flows, was designed and fabricated. The test loops to evaluate the flow meters for water flow, as well as Freon -113 flow which simulates the hypergolic fluids, were modified and constructed to utilize a pump system which has an output capacity of 200 gpm. Test runs were conducted on the small 1/2 inch model with Freon 113 and on the larger models with water. Results showed that the linearity between the frequency of the vortices and the flow rate of the fluids was very close to that of the turbine flow meter. It is suggested that the vortex shedding flow meter is a possible replacement for the existing turbine type. Author

N92-19323*# North Carolina Univ., Charlotte. Dept. of Engineering Technology.

STUDY AND DEVELOPMENT OF AN AIR CONDITIONING SYSTEM OPERATING ON A MAGNETIC HEAT PUMP CYCLE c37

Pao-Lien Wang *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 535-553 (For primary document see N92-19306 10-99)

Avail: NTIS HC/MF A99 CSCL 13I

This report describes the design of a laboratory scale demonstration prototype of an air conditioning system operating on a magnetic heat pump cycle. Design parameters were selected through studies performed by a Kennedy Space Center (KSC) System Simulation Computer Model. The heat pump consists of a rotor turning through four magnetic fields that are created by permanent magnets. Gadolinium was selected as the working material for this demonstration prototype. The rotor was designed to be constructed of flat parallel disks of gadolinium with very little space in between. The rotor rotates in an aluminum housing.

The laboratory scale demonstration prototype is designed to provide a theoretical Carnot Cycle efficiency of 62 percent and a Coefficient of Performance of 16.55. Author

N92-19324*# State Univ. of New York, Albany. Dept. of Electrical Engineering.
EVALUATION AND ANALYSIS OF THE ANSI X3T9.5 (FDDI) PMD AND PROPOSED SMF-PMD AS INFLUENCED BY VARIOUS FIBER LINK CHARACTERISTICS c74
M. Chris Wernicki *In* University of Central Florida, NASA/ASEE Summer Faculty Fellowship Program. 1991 Research Reports Nov. 1991 p 554-595 (For primary document see N92-19306 10-99)
Avail: NTIS HC/MF A99 CSCL 20F

The purpose of this project is to evaluate the operational parameters of the Kennedy Space Center (KSC) fiber optic cable plant. The evaluation is based on the Fiber Distributed Data Interface (FDDI) Physical Medium Dependent (PMD) and Single Mode Fiber (SMF) PMD standards. From the KSC fiber profile, it would be necessary to develop the modifications needed in existing FDDI PMD and proposed SMF-PMD standards to provide for FDDI implementation and operation at KSC. This analysis should examine the major factors that influence the operating conditions of the KSC fiber plant. These factors would include, but are not limited to the number and type of connectors, attenuation and dispersion characteristics of the fiber, non-standard fiber sizes, modal bandwidth, and many other relevant or significant fiber plant characteristics that effect FDDI characteristics. This analysis is needed to gain a better understanding of overall impact that each of these factors have on FDDI performance at KSC. Author

N92-19411# European Space Agency, Paris (France).
CATALOGUE OF ESA PATENTS
P. A. Kallenbach, comp. and B. Battrick, comp. Jul. 1991 45 p Revised Original contains color illustrations
(ESA-SP-1131-Rev-1; ISBN-100-05-1131; ISSN-0379-6566; ETN-92-90748) Copyright Avail: NTIS HC/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 25 Dutch guilders

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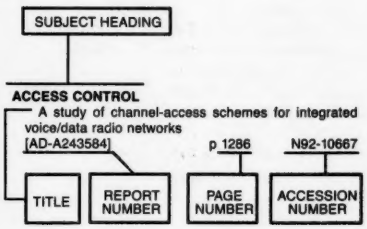
N92-19412# European Space Agency, Paris (France).
CATALOGUE OF ESA PUBLICATIONS IN 1990
B. Battrick, comp. and F. deZwaan, comp. Jul. 1991 55 p
(ESA-SP-1145; ETN-92-90749) Avail: NTIS HC/MF A04

Publications produced by the ESA publications division in 1990 are listed both by category and by subject. The document categories include: ESA bulletins, ESA journals; special publications, brochures; scientific and technical reports; and procedures, standards, and specifications. General subject categories include astronautics, engineering, geosciences, life sciences, mathematical and computer sciences, physics, social sciences, space sciences, and general. Each of these are subdivided into more specific subjects. ESA

N92-19537*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
RESEARCH AND TECHNOLOGY, 1990 Annual Report
P. Y. Potter 1990 268 p Original contains color illustrations
(NASA-TM-103510; NAS 1.15:103510) Avail: NTIS HC/MF A12; 2 functional color pages CSCL 05B

The annual report of the Marshall Space Flight Center for 1990 is presented. Brief summaries of research are presented for work in the fields of transportation systems, space systems, data systems, microgravity science, astronomy, astrophysics, solar physics, magnetospheric physics, atomic physics, aeronomy, Earth science and applications, propulsion technology, materials and processes, structures and dynamics, automated systems, space systems, and avionics. Author

Typical Subject Index Listing



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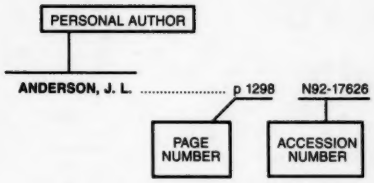

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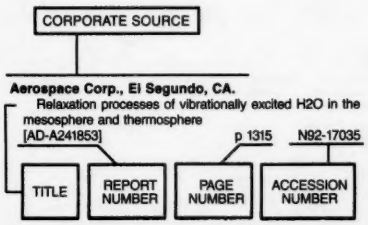

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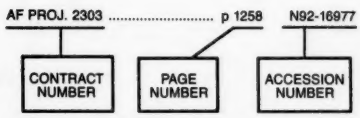

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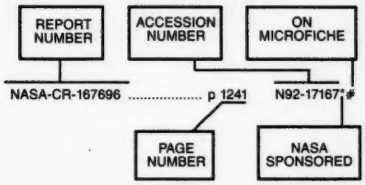

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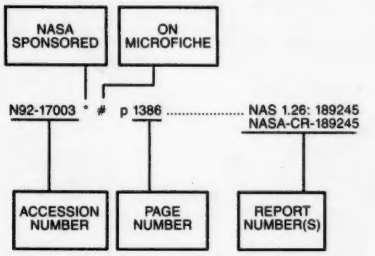

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Documents Dept.
Stillwater, OK 74078
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UTAH STATE UNIV.
Merrill Library & Learning Resources Center, UMC-3000
Documents Dept.
Logan, UT 84322-3000
(801) 750-2684 FAX: (801) 750-2677

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